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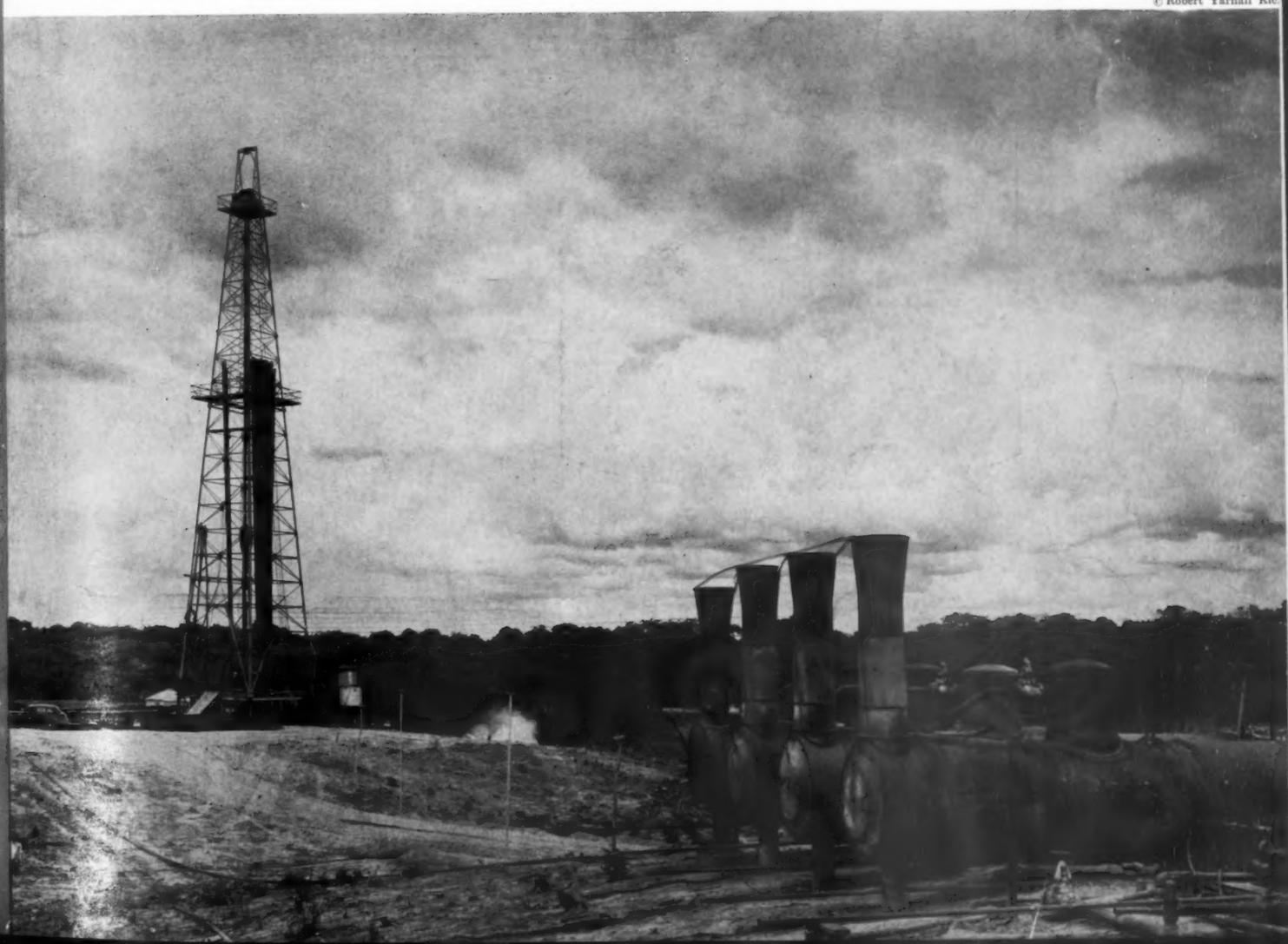

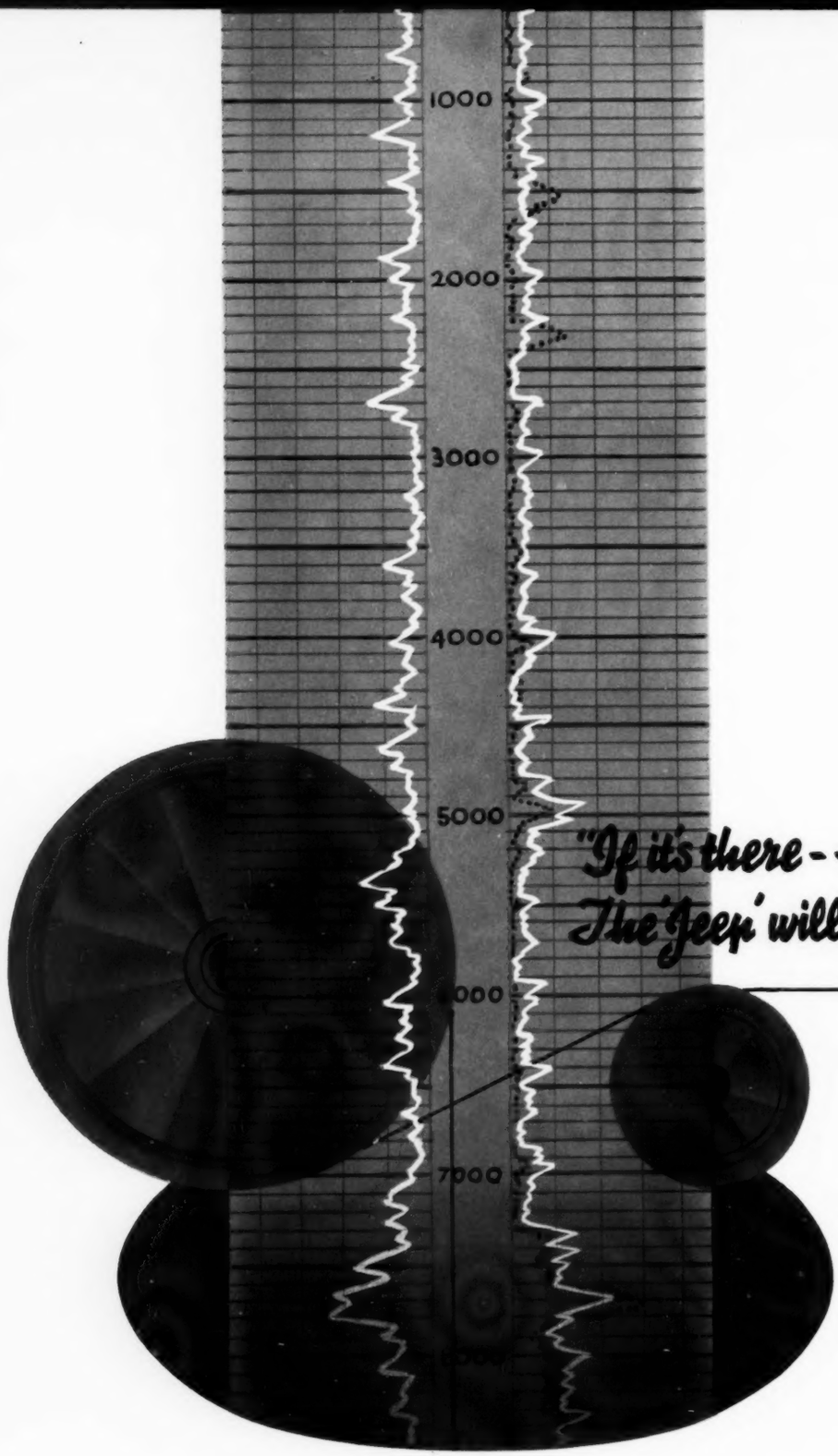

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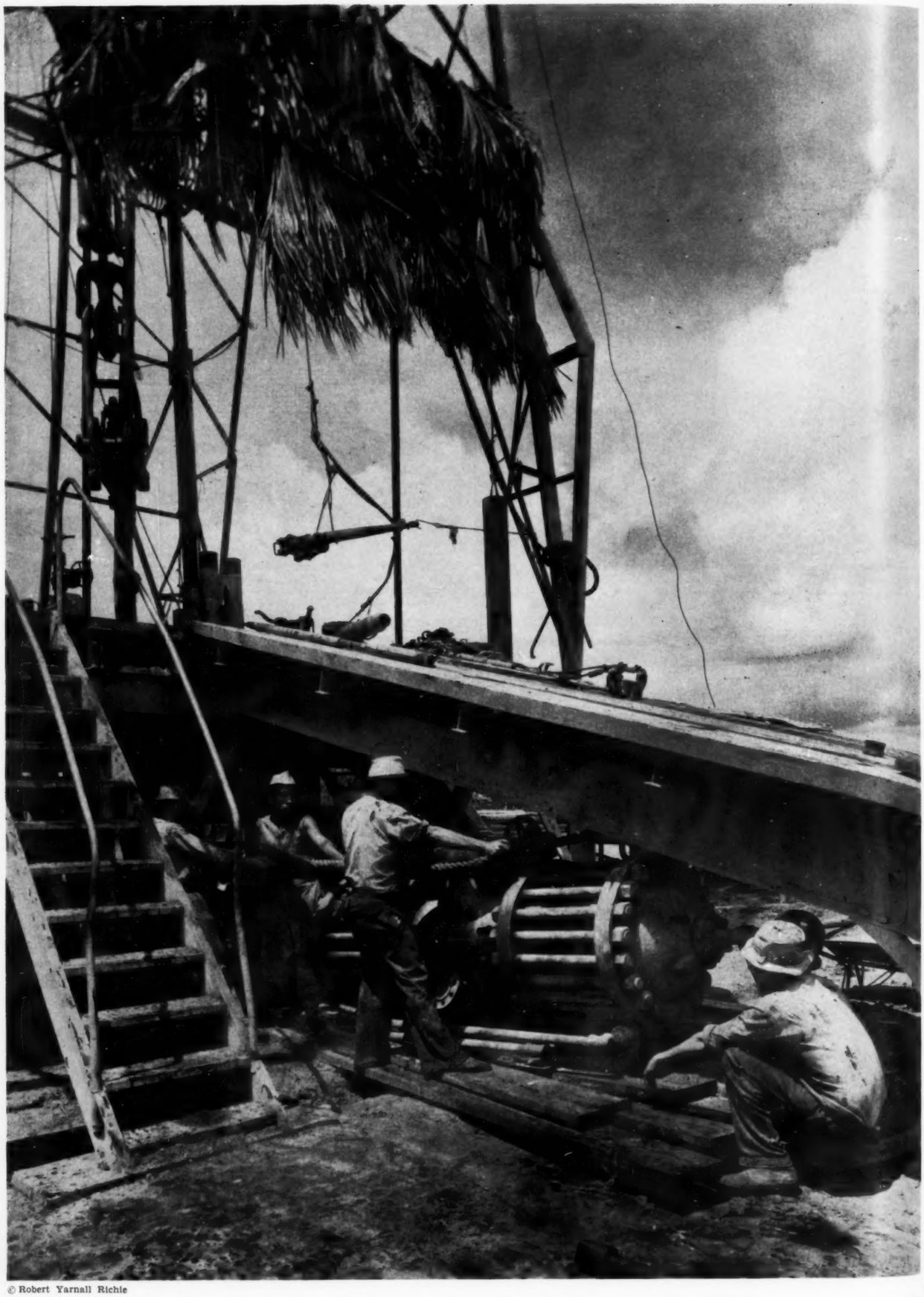

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Front cover illustration shows development drilling in Standard Oil Company of Venezuela's San Joaquin field in Eastern Venezuela: illustration above shows the use of modern type blow-out preventer on an Eastern Venezuela wildcat.

EDITORIAL

TRANSLATING GOOD WILL INTO PRACTICAL APPLICATION

UNQUESTIONABLY the ties between North and South America have been drawn closer by the events of the past year in Europe. The spectacle of formerly free nations overwhelmed by force and treachery, deprived of their political entity or reduced to economic subjection no less humiliating has not been lost upon the peoples of the Western Hemisphere who are determined to stand together in defense both of their political rights and their commercial independence.

While the formulation of plans for territorial defense has held first place in public discussion, naturally enough under the circumstances existing, it is encouraging to note that the movement for closer cooperation on the economic front is taking practical form.

In discussion of inter-American commerce, it is sometimes assumed that because the two continents to some extent produce for export similar products, no large expansion of trade is possible. Examination of actual conditions, however, reveals that this obstacle is less formidable than it is represented to be. Exchanges of goods between the United States and Latin America, for example, are not badly unbalanced. In the case of individual countries, there may be considerable discrepancies but for the whole group the balance either way to be settled by currency payments or services is scarcely more than 10 percent.

The basis for a greater degree of financial cooperation has been provided by the recent enlargement in scope and capital of the Export and Import Bank in Washington. Private capital in the United States likewise stands ready to extend the vast commitments which it previously has made to the development of South America's resources and the consequent strengthening of its economic position.

The only sound basis for successful cooperation is mutual good will which implies the joint recognition of obligations as well as opportunities. The United States and Latin America are ideally suited to work together on this basis of friendly self-interest because the former has the capital and enterprise needed by the latter and because it has no ambition to dominate the economic life of its neighbors or to use a commercial foothold for purposes of political penetration.

Developments of the petroleum resources of the Southern continent, a process which is far from complete despite the great progress that has been made, is a case in point. Without the financial resources acquired by large oil companies elsewhere, without their willingness to risk tens of millions of dollars on the chance of worthwhile discoveries, and without their technical experience and advanced equipment, this development would have been impossible. From time to time, agitators in different countries have attempted to represent those conducting these operations as "exploiters of national resources" but the fact is, as pointed out on other pages of this issue, that their work has led in reality to the creation of new wealth which is disseminated throughout the nation, the extension of employment, the support of the fiscal structure and the fortification of the country's trade position. Whatever profit these builders of industry may have obtained from their investments and their efforts are of infinitesimal proportions compared to the benefits necessarily disseminated in the course of their operations.

Sometimes a tendency appears, even in countries whose policies in the main are fair and constructive, to view corporations financed by outside capital as fair game for petty extortion, oppressive taxes and cumbersome regulations which hamper progress. Such practices really injure the state in whose name they are issued. They cause ill-feeling, discourage new investment and form a barrier against progress without any compensating advantage.

In two conspicuous cases, governments have been misled by greed into outright seizure of properties developed by private capital in the mistaken belief that thereby they might derive larger monetary returns. In both cases the result has been the replacement of substantial and dependable fiscal income by deficits and a serious weakening of the economic structure.

Progress in Balancing Yields of Major Products With Consumption

The Author of the Article on Unbalanced Stocks of Light Products, that Attracted Widespread Attention in the March, 1940 Issue of World Petroleum, Now Suggests a Program Designed to Avoid a Distillate Fuel Oil Shortage Without Overstocking Gasoline.

REFINERS and marketers, particularly the refiners along the East Coast and Gulf Coast, and the marketers along the Atlantic Seaboard who found themselves in a relatively tight distillate fuel oil position at the end of 1939 and the first three or four months of 1940, apparently are determined not to be caught short in the coming winter as they were last winter. During recent weeks a great deal of progress has been made in accumulating stocks for the forthcoming winter. With these stocks close to their desirable levels for this time of the year and with gasoline stocks far in excess of their proper levels, runs to stills East of California now can be reduced to around 2,900,000 bbl. a day as the additional amount of distillate fuel oil required for the forthcoming winter can be secured from such an amount of crude by a slight betterment in the distillate fuel oil yield.

The necessity for accumulating stocks of distillate fuel oil during the summer months was brought out in the March, 1940 issue of WORLD PETROLEUM in an article entitled "Unbalanced Position in the Demand for Light Products Growing Acute." During the summer months a number of companies erected additional storage in the terminals along the Atlantic Seaboard in which to store distillate fuel oil against winter consumption.

A comparison of the distillate fuel stocks for all districts at critical dates this year with those of last year is shown in the accompanying Table 1. This table also shows the desirable level of stocks at September 30, 1940 and the estimated safe working level at March 31, 1941.

In the Atlantic Coast and Gulf Coast refining districts close to 13,000,000 bbl. of distillate fuel oil were added to inventories in the months of June, July and August. Because of the increase in demand* during the month of September it is neither likely nor in fact possible for a corresponding amount to be added to stocks unless the yield of distillate fuel oil from crude is raised considerably above the percentage that has been realized during recent months. However, it does appear likely that stocks at September 30th will be on the order of 28,000,000 bbl. in these districts. Such a backlog would permit the withdrawal of around 18,000,000 bbl. during the six winter months without scraping bottoms as compared to 10,800,000 bbl. withdrawn in the period October 1, 1939 to March 31, 1940.

*It should be borne in mind that "demand", according to the generally accepted statistical definition used by both the Bureau of Mines and the A. P. I. really constitutes shipments from reported storage, that is, the terminals or the refineries, to unreported storage such as bulk depots and consumers' tanks.

In the middle western states comprising Indiana, Illinois, Kentucky, Oklahoma, Kansas, Missouri, Arkansas, North Louisiana, and Inland Texas, the additions to stocks have not been so substantial. At August 31st, the stocks in this inland territory are estimated to be about 7,700,000 bbl. as compared to 7,100,000 bbl. at August 31st, 1939. However, some further additions reasonably can be expected during September, so that it is likely that the September 30th stocks will be considerably above those of a year ago. The inventory position in these states last winter was not as acute as on the Atlantic Seaboard, yet it was necessary to maintain runs to stills at a relatively high level during the last quarter of 1939 and the first quarter of 1940 to meet the demand. Everything considered, it appears that the accumulation of distillate fuel oil in these states during recent months has not been as great as is desired.

For that part of the United States East of California stocks at August 31st were approximately 35,000,000 bbl., an improvement of nearly 7,500,000 bbl. over the level a year previous.

The desirable level of stocks at September 30 is, of course, a function of weather that is to follow in the succeeding six months which cannot be foretold; but in order to meet the requirements for a normal winter it has been estimated that stocks of distillate fuel oil east of California at September 30 should be on the order of 38,000,000 to 40,000,000 bbl.

Unfortunately such improvement as has been shown in the inventory position just mentioned, has been achieved by maintaining runs to stills at high levels rather than by taking a high yield of distillate fuel oil from crude. Although these yields were held at fairly high percentages up through April, a sharp reduction was noted in May and June. Strangely enough the reduction in the yield of distillate fuel oil was not accompanied by an

TABLE I

Distillate Fuel Oil Stocks
Comparison 1940-1939
(Thousands of Barrels)

	March 31		June 30		July 31		August 31		Sept. 30		
	1939	1940	1939	1940	1939	1940 Estimated from A.P.I. Published Statistics	1939	1940 Preliminary Estimate	1939	Minimum Desirable Level Sept. 30, 1940	Safe Level Mar. 31, 1941
East Coast	7,363	5,683	9,281	10,694	11,414		12,675		13,094		
Texas Gulf Coast	3,846	3,306	5,458	5,699	5,837		6,380		6,455		
Louisiana Gulf Coast	816	631	1,045	1,247	1,174		911		852		
TOTAL	12,025	9,620	15,784	17,640	18,425	22,600	19,966	26,600	20,401	29,000	10,500
Indiana, Illinois, Kentucky	2,211	2,452	3,270	4,025	3,984		4,692		4,810		
Oklahoma, Kansas, Missouri	1,154	881	1,603	1,209	1,801		1,784		1,821		
Inland Texas	273	128	277	192	330		346		363		
North Louisiana and Arkansas	193	125	231	204	242		251		218		
TOTAL	3,831	3,586	5,381	5,630	6,357	6,800	7,073	7,700	7,212	8,600	4,000
Appalachian	268	312	244	319	269	350	253	400	318	600	500
Rocky Mountains	215	266	197	272	215	250	217	300	227		
California	9,560	9,302	10,271	9,724	10,074	9,800	10,117	10,000	9,980	10,000	9,000
United States	25,899	23,086	31,877	33,535	35,340	39,800	37,626	45,000	38,138	48,200	24,000
East of California	16,339	13,784	21,606	23,861	25,266	30,000	27,509	35,000	28,158	38,200	15,000

increase in the yield of gasoline nor was it reflected in the yield of residual fuel oil. Rather the reduction in yield is reflected in the very considerable increase of about 4,000,000 bbl. in stocks of unfinished oils during the months of April, May and June. Presumably the bulk of this unfinished product added is gas oil, which can be converted into distillate fuel oil or cracked to produce gasoline. It appears, therefore, that over the last three or four months the industry has maintained runs to stills at levels higher than can be justified on economic grounds, taking from the crude a relatively low percentage of gasoline as compared to the previous summer and about a normal distillate fuel oil yield and leaving the balance of the distilled product in the unfinished state to be converted to burning oil if the occasion arises.

The industry's inventories of unfinished oils constitute potential supplies of products which cannot be ignored in any analysis. Table II shows these stocks by months for the year 1939 and the first six months of 1940.

TABLE II

Stocks of Unfinished Oils East of California

(Thousands of barrels)

	1939	1940
January 1	34,967	32,854
January 31	34,207	32,161
February 28	34,089	32,246
March 31	34,147	32,687
April 30	33,720	34,103
May 31	34,189	35,647
June 30	34,699	36,733
July 31	36,077	
August 31	36,504	
September 30	36,496	
October 31	34,722	
November 30	33,709	
December 31	32,854	

At September 30, 1939 they amounted to 36,500,000 bbl. East of California. At March 31, 1940 they had been reduced to 32,700,000 bbl. At June 30 they were back to 36,700,000 bbl. (41,300,000 bbl. for the United States). Thus it would appear that some of the supplies of distillate fuels for which the demand developed so suddenly last winter were found in this mystery stock of unfinished oils and that the additions in the second quarter of 1940 constitute a similar reserve.

It is entirely superfluous to present any statistics or extensive analysis to support the statement that gasoline stocks are excessive; it is recognized by everyone in the industry. The idea of reducing these stocks to minimum working levels on September 30 of this year was discarded months ago. The same fatalistic attitude should not be displayed with respect to the levels of gasoline inventories at March 31, 1941. The question as to the proper levels of gasoline as of that date for convenient and economic operation during the following summer has been discussed many times in the past and there is little that could be added at this time. The opinion of economists who have studied the matter indicates that the proper level of stocks at March 31 is 82,000,000 to 85,000,000 bbl. for the United States or around 67,000,000 to 70,000,000 bbl. for that part of the United States east of California.

Stocks of gasoline on September 30th probably will be on the order of 80,000,000 bbl. for the United States or 64,000,000 bbl. East of California, representing a surplus of about 15,000,000 bbl. above the minimum working level. In view of such a surplus and considering that the position of distillate fuel oil inventories has shown remarkable improvement and that the unfinished oils contain a hidden reserve of probably 4,000,000 bbl. of distillate fuel oil which could be drawn upon in an emergency should extremely cold weather occur, it seems clear that the principal objective of refiners should be to liquidate their surplus gasoline inventories and obtain their distillate fuel oil supplies from reduced crude runs.

The position at the present time is not at all hopeless. If runs to stills are reduced to around 2,900,000 bbl. a day, east of California, and maintained at that level until the end of March 1941 with a distillate fuel oil yield of 14.6 percent, and a gasoline yield of around 44.5 percent, the demand for both products from now until March 31, 1941, can be met, gasoline stocks can be held to 70,000,000 bbl. east of California at March 31, 1941, and unless another severe winter is encountered, distillate fuel oil stocks will not go below the level for convenient operation which is estimated at 15,000,000 bbl. at the end of the winter. The details of these calculations are shown in Table III alongside the comparison with the actual position a year before.

In the forecast—Table III— domestic demand for gasoline is estimated at five percent over the previous year. The estimate of gasoline exports is approximately 50 percent lower than the previous period. Actually it might be as well to ignore completely the export position and base any estimate of motor fuel demand entirely on domestic consumption. Exports of gasoline probably will account for less than three percent of the total demand over the six months under consideration.

Any attempt to forecast the demand for distillate fuel oil over this six months period involves the one great inherent uncertainty—the weather. Over an entire year, more than 80 percent of all the distillate fuel oils consumed east of California is used for heating; the remainder, of which one-half is used for Diesel fuel, is consumed in industry. During the winter months this percentage is, of course, substantially higher, possibly on the order of 95 percent. The new peak in demand which was reached in the winter of 1939-40 was, of course the result of a substantial increase in the number of burners (estimated to be about 12 percent) coupled with an extremely severe winter. During the winter 1940-41 it is estimated that there will be another increase of 12 to 13 percent in burners. Assuming that the winter will be normal rather than a repetition of the previous winter, it is estimated that the increase in the demand for distillate fuel oil including that used in industry as well as that used for heating will amount to approximately 11 percent. This is a composite figure which provides for the increase of 13 percent in burners with a normal winter's requirements and an increase of approximately 10 percent in industrial use. Exports of distillate fuel oil are estimated considerably below those of the previous year because of the current European situation.

TABLE III

Forecast of Supply and Demand of Gasoline and Distillate Fuel Oil East of California
October 1, 1940 to March 31, 1941

(Thousands of Barrels)

	GASOLINE			DISTILLATE FUEL OIL		
	Estimated Oct. 1, 1940 to Mar. 31, 1941	Actual Oct. 1, 1939 to Mar. 31, 1940	Percent Change	Estimated Oct. 1, 1940 to Mar. 31, 1941	Actual Oct. 1, 1939 to Mar. 31, 1941	Percent Change
Crude Run to Stills—Daily Average	2,900	2,950		2,900	2,950	
Total	528,000	539,868		528,000	539,868	
Yield	44.5%	45.2%		14.6%	14.1%	
Refinery Output from Crude Oil	235,000 (a)	249,349 (a)		77,300	76,575	
Non Refinery Supplies:						
Natural Gasoline and Benzol	20,500	21,138				
Imports		157		1,000	900	
Transfers from Crude	.....	.....		3,200	3,194	
Receipts from California	1,000	1,515		500	601	
TOTAL	21,500	22,810		4,700	4,695	
TOTAL SUPPLY	256,500	272,159		82,000	81,270	
Demand—Domestic	245,000	232,850	+5.2%	100,000	89,893	+11%
Export	5,500	11,034	—50.0%	5,000	5,751	—13%
TOTAL	250,500	243,884	+2.7%	105,000	95,644	+10%
To or (From) Stocks	6,000 (a)	28,275 (a)		(23,000)	(14,374)	
Stocks —Sept. 30—Beginning of Period	64,000 (a)	56,363 (a)		38,000	28,158	
Mar. 31—End of Period	70,000 (a)	84,638 (a)		15,000	13,784	

(a) Finished and Unfinished Gasoline.

The proposed yield of 14.6 percent for this period is only 0.5 percent higher than was realized during the corresponding period a year before and the recent trend in distillate fuel oil yield indicates that it will be realized. If such a program were followed the industry would find it unnecessary to build up huge gasoline stocks in the first quarter of the year while crude was being run to supply the demand for heating oils, and in fact, the damage done by this practice in the last two years could be corrected.

The total demand for crude oil must take into consideration the amount to be exported, the amount to be consumed as fuel principally within the industry, and the amount to be imported as well as the amount required for refining. At the present time the future trend of exports and imports is most difficult to foretell. Possible embargoes and proposed legislation against imports leave the subject surrounded by question marks. However, as to the area east of California it is reasonably satisfactory to expect the exports approximately to equal imports, that is, to offset one against the other and arrive at the total demand for crude oil by adding the crude to be used as fuel, amounting to about 35,000 bbl. a day, to the required runs to stills. On this basis the demand for crude oil east of California amounts to about 2,935,000 bbl. a day.

For several months past, crude oil production has been far in excess of the demand; in the peak month of March, 1940 it amounted to 3,271,100 bbl. a day east of California. Over 25,000,000 bbl. of crude have been added to storage east of California since the first of the year. The oil producing states have recently reduced their allowables to an amount which, if adhered to, will result in crude oil production of around 2,900,000 bbl. a day east of California, and will permit a slight reduction in present crude inventories. It appears that the proration authorities of the various states having production control are appreciative of the present critical condition and realize the dangers ahead unless crude oil production is kept within the demand.

Mexican Oil, Shut Off From Dictator Nations, Invades U. S. Markets

WASHINGTON, D. C.

WITH EXPORT demand for petroleum products of the United States reduced to a fraction of its normal proportions and with the necessity of applying still more drastic curbs to domestic production increasingly strong protests are being voiced, particularly by independent producers in the southwest, against the rapidly swelling volume of Mexican oil that is pouring into the country. Complaint is made not only of the extent of these imports but also because of the fact that this oil, being drawn from properties which Mexico seized from their owners over two years ago, can be sold at prices which it is impossible for American producers to meet.

Prior to confiscation the marketing of Mexico's surplus oil offered no problem to the Mexican government. Its distribution was in the hands of the large operating companies who refined the greater part of the crude output in refineries located within the country and shipped the manufactured products abroad in their own tankers. Taxes on oil and oil properties formed one of the main sources of federal revenue. Chief markets for exported products were the United Kingdom, Western Europe and Latin American countries.

Following the seizure of the oil properties, the former operators were neither able nor willing to provide markets. When the British government protested seizure, Mexico broke off diplomatic relations and Mexican oil was barred from Great Britain. Other possible purchasers lacked facilities for moving the oil, and the Mexican authorities had no equipment for trans-oceanic shipments.

Germany, however, was one country that was anxious to obtain oil in order to build up reserves against an anticipated European conflict. Though unable to pay cash for such supplies, an arrangement was worked out for the exchange of machinery, pipe and other German made goods for great quantities of Mexican oil. Facing the lack of other available outlets, this barter deal was eagerly sought by Mexico. Exports to Germany which had amounted to 2,500,000 bbl. in 1937, rose to 5,154,000 bbl. in the eight months of 1938 following expropriation and to 6,342,000 bbl. in the period from January 1939 to the outbreak of war on September 1. During this time, Germany was the most important single purchaser of Mexican oil.

The example of Germany was followed by Italy and a barter arrangement was made for the exchange of Italian rayon and other products for Mexican petroleum. Shipments to Italy, which had amounted to 137,000 bbl. in 1937, increased to 4,765,000 bbl. in 1939 and further exports of 2,958,000 bbl. were made in the first half of 1940 before they were shut off by Italy's entrance into the war. Japan also has been giving increased attention to Mexico as a possible source of needed oil, but purchases for Japanese account thus far have been on a very limited scale. Within the past two years, however, Mexico has supplied upward of 20,000,000 bbl. of oil to swell the war stocks of the three great totalitarian nations.

With the whole of Europe shut off by the British blockade, Mexico is no longer able to send to Germany and Italy the large quantities of oil which she was shipping to these two countries under barter agreements up to the beginning of the war. Consequently, the sales agency of the Mexican government is trying by every possible means to find outlets for its production in the United States, apparently with little regard to whether the price obtained results in a profit or loss.

The rapidly increasing share of the United States market that is being taken over by Mexican oil is shown by the following figures of imports from that country.

Date	Bbl.
March 1938	55,000
March 1939	124,000
March 1940	934,000
July 1940	1,862,000

March 18, 1938, was the date when the Mexican government ousted the oil companies that had been operating there for many years and confiscated their properties, including wells, pipelines, refineries and stocks on hand. Nothing was paid to the owners at that time for any part of the properties and the Mexican government came into possession of a fully equipped and going business in which many millions of dollars had been invested at no cost to itself.

During 1938, very little Mexican oil reached the United States and most of that was entered in bond for re-export after refining. By March 1939 imports from Mexico had reached 4,000 bbl. daily. During the remainder of the year they continued to rise, particularly after the outbreak of war in Europe had shut off shipments to Germany. By March 1940, Mexican exports to the United States had grown to 30,000 bbl. daily and in July they jumped to 60,000 bbl. This is a quantity greater than the average monthly total of Mexican exports to all countries during 1939. Apparently, therefore, practically the entire output of Mexican wells, above the amount required for domestic use, is being unloaded upon the United States. Since the published plans of the Mexican oil monopoly call for a considerable increase in production during the year, the chances are that the flood of Mexican oil pouring into the

United States will increase rather than diminish as time goes on.

Receipts from Mexico are mainly Poza Rica crude of 31 deg. API, which is capable of good yields of gasoline and so enters directly into competition with domestic oils.

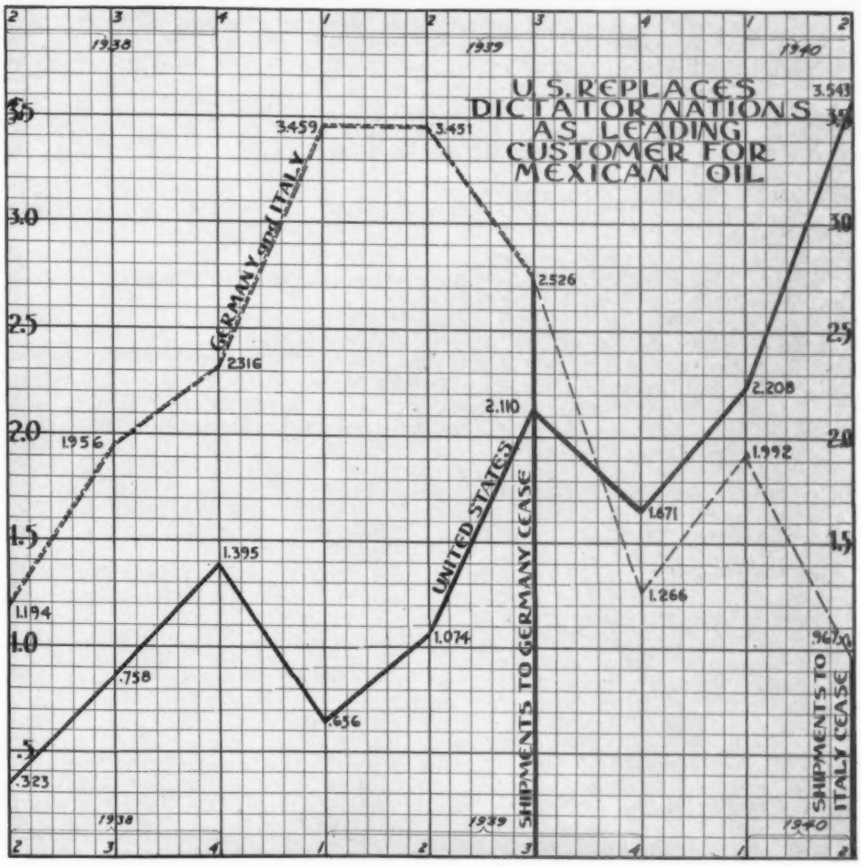
The tariff of 21 cents per bbl. apparently is no deterrent to the movement from Mexico. One reason for this can be deduced from a contract involving the sale of millions of barrels of oil which created something of a furore when it was made public in Mexico recently. In fact the publicity given to this particular deal by the Mexican press is generally assigned as the reason for the resignation of Dr. J. Silva Herzog from his post at the head of the Mexican sales organization.

This contract was concluded on June 22 between Distribuidora de Petroleos Mexicanos, sales agency for the government oil monopoly, and Sr. Jorge Henriquez Guzman as manager of Industriales Petroleos S.A., to take effect from August 1. Sr. Henriquez, it appears was the holder of a credit against the Mexican treasury of 4,202,267 pesos, presumably acquired in connection with the building of the Guadalajara highway, in which Senator Domaso Cardenas, brother of the President, figured prominently.

According to the terms of the contract Industrialias Petroleos was to purchase from Distribuidora 1,200,000 bbl. of Poza Rica crude annually for a period of five years with the option of increasing the quantity to 3,600,000 bbl. The oil was to be valued on a sliding scale based on Gulf Coast quotations. The buyer was to pay forty cents per bbl. in U. S. currency and the remainder of the price was to be charged against his credit until the full amount was covered. Since the oil was to be delivered duty paid to buyers' tanks or barges in New York harbor only 19 cents per bbl. would remain out of the 40 cents after payment of the import duty with which to meet the cost of transportation and the Mexican export tax of 30 cents per bbl. The selling company therefore would be out of pocket on the transaction except that through acquisition of the credit referred to it would be able to reduce the debt of many millions of pesos which it owes to the government.

From the viewpoint of the buyer the cost of the crude would depend upon the value placed upon the claim against the Mexican government. If this were to be appraised on the basis of other obligations of the government it would be worth only a small fraction of its face value. The possibilities contained in the possession of high grade crude such as that obtained from Poza Rica at a cash outlay of only 40 cents a barrel are obvious.

One reason for the willingness of Mexico to make terms such as were contained in this contract is said to be the difficulty the Mexican sales agency has encountered in selling crude to U. S. refiners and the belief that it is far easier to find outlets for refined products through the multitude of dealers in all parts of the country. In this connection it is noted that negotiations have been under way recently, reputedly by Mexicans



Mexican oil exports to U. S. and dictator nations: Millions of barrels for three-months periods since expropriation.

interested in the contract referred to, for the purchase of the Middlesex refinery located on the Raritan river in New Jersey. This refinery is described as a 5,000 bbl. topping plant and its location is considered disadvantageous since its crude supply must be transferred to barges for delivery to the plant. In the case of the holders of the Mexican contract this would prove no particular handicap inasmuch as the seller is required to deliver oil to barge or shore storage without extra charge.

The rate of increase in Mexican shipments is limited only by the amount of oil which the government can produce and dispose of. At present, production of the Poza Rica field is running at the rate of approximately 85,000 bbl. per day, but Ing. Cortez Herrera, manager of the government-operated company, and Minister of Finance Suarez, have announced that production in the Poza Rica area will be increased to at least 200,000 bbl. per day before President Cardenas leaves office on December 1.

An indication of the importance which Mexico places upon maintaining an entry into United States market for unlimited quantities of its oil is afforded by the protest which the Mexican Ambassador at Washington lodged against a bill recently passed by the United States Senate and now pending in the House of Representatives. This bill seeks to extend the provisions of the National Stolen Property Act. This, it will be recalled, was an outgrowth of the "Dyer Act" designed to prevent the transportation of stolen automobiles from one state to another. This new bill has as its purpose to meet the emergency created by the war in Europe. It seeks to curb the introduction into this country of confiscated and stolen goods. It is advocated as a measure of protection to American merchants and manufacturers. As a rule the confiscators and those who receive confiscated property have obtained it without capital cost. Their agent can trade or sell such property at prices which defy competition. World conditions resulting in the breakdown of standards and in wholesale acts of confiscation by governments threaten large-scale dumping of confiscated goods in this country.

By extending to international trade the same prohibition already applied in interstate trade, the new bill seeks to apply in international relations those same standards which govern at home.

Although this bill was originally introduced with European nations in mind, the fact that the Mexican Ambassador in Washington protested against it called attention to its possible applicability in the case of oils seized from American oil companies in Mexico. There is no other explanation for this unusual interposition on the part of the Mexican Government than that if this bill becomes a law, it may prohibit the sale in the United States of oil which Mexico confiscated from American owners. In view of this possible application American oil producers who feel themselves injured or threatened by the competition of the Mexican light crudes which the Mexican government has been extracting from the confiscated properties have a special interest in the early passage of the bill by the House of Representatives.

MUTUAL GOOD WILL

Real Keystone of Pan American Development

Progress and Stability of Latin American Nations Dependent on Utilization of Resources Through Capital and Technical Ability Which United States Alone is Prepared to Supply Without Political Aims

Showing the practical and psychological attitude of Latin American public opinion towards the cooperation of American capital and technical ability in the development of natural resources in those countries, "World Petroleum" presents the accompanying article by a well-known Latin American economist. It reflects the trend of Latin American sentiment and thought, its changing reaction in relation with the role which the United States is called upon to assume in the world of today. Continental "good will" is sincerely shared by Latin Americans, who understand and respect the essential function which American capital and technique must perform in the development of their countries. They recognize, at the same time, the imperative need of a fair and just fulfillment of mutual rights and responsibilities by the governments of America in the common task of accelerating the progress and well being of the peoples of the Western Hemisphere.

IN THE picture of modern industrial progress, two great groups of industries stand out: those which are engaged solely in the exploitation of natural resources; and those which, at one and the same time, develop them and create new wealth.

The first group concerns itself simply with the extraction of all possible immediate value from existing sources of wealth, with regard neither for the future nor for the improvement of the particular region in which it is found. This type of industry is exemplified by the lumber cutting industry as it was carried out in the past in many countries. In order to take advantage of rich forests for immediate commercial purposes, immense regions were devastated so that not only have they been rendered unproductive but in some places they have been transformed into veritable threats to the national economy. Destructive floods in many parts of the world illustrate this reality.

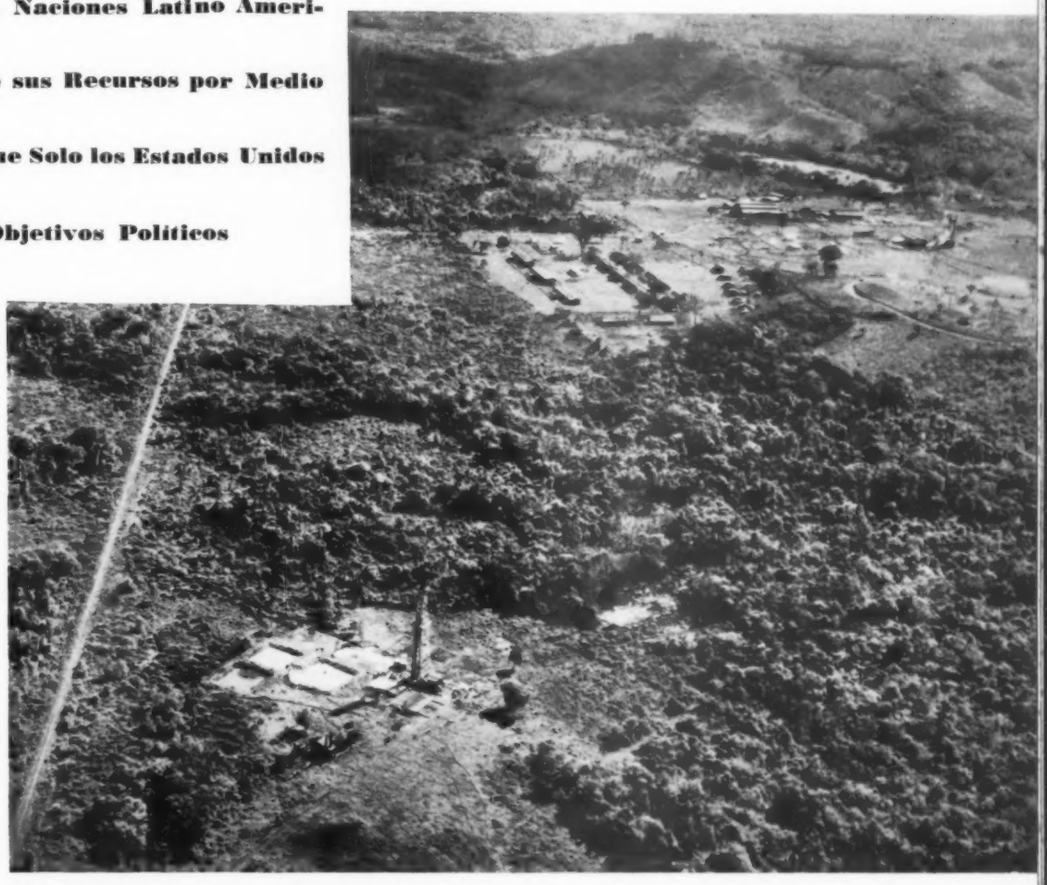
There are, however, industries which, while exploiting natural resources, create new wealth in the territories where they operate, opening up vast sources of progress and well-being for the people at large. The modern petroleum industry is typical of this classification. It is one which has contributed most directly to human progress in the past forty or fifty years. In the last quarter of a century it has realized real miracles in some of the most important parts of Latin America. The generous objective of promoting a true "good will" among its peoples, does not have a better servant than this industry.

The usefulness of its work will be accentuated among the Latin American nations in the coming years, if the course of its normal progress is not retarded or obstructed by artificial and destructive efforts. Such a possibility is condemned by the best and most level-headed spirits on the American continents, to whom it daily becomes more evident that there are few inter-American enterprises in which the possibilities of practical, con-

The oil industry has made a thriving industrial and shipping center out of the Lake Maracaibo area of Venezuela, an area that would have been poorly suited to other forms of development.

LA "BUENA VOLUNTAD"
Recíproca Verdadera Base del Progreso Pan Americano

El Desarrollo y Estabilidad de las Naciones Latino Americanas Depende de la Utilización de sus Recursos por Medio del Capital y la Pericia Técnica que Solo los Estados Unidos están en Disposición de Suplir sin Objetivos Políticos



Airview of Poza Rica field in Mexico taken by Mexicana Aerofoto, S. A. just prior to confiscation of the property.

Indicando la actitud práctica y psicológica de la opinión pública de la América Latina, en relación con la cooperación del capital y la pericia técnica norteamericanos en el desenvolvimiento de los recursos naturales de esos países, WORLD PETROLEUM presenta el artículo siguiente:

Refleja la orientación del sentimiento y el pensamiento latinoamericanos, sus reacciones cambiantes en referencia al rol que, en el mundo del día, están llamados a asumir los Estados Unidos.

La "buena voluntad" continental es sinceramente compartida por los latinoamericanos, quienes comprenden y respetan la función esencial que el capital y la técnica americanos deben llenar en el desenvolvimiento de sus países. Reconocen, al mismo tiempo, la necesidad imperativa de un equitativo y justo cumplimiento de los derechos y responsabilidades mutuas por los gobiernos de toda América, en la tarea común de acelerar el progreso y el bienestar de los pueblos del Hemisferio Occidental.

En el cuadro del progreso industrial moderno, destácanse dos grandes grupos de industrias: las que están dedicadas solamente a la explotación de los recursos naturales; y las que, al mismo tiempo que los explotan, crean nueva riqueza.

El primer grupo se interesa simplemente en explotar las fuentes de riqueza existente, extrayendo todo el valor inmediato posible de ella, sin atención al futuro ni a las posibilidades de mejoramiento del territorio en que se encuentra. Ejemplo de este tipo de industria preséntalo la explotación maderera en la forma en que se realizó en el pasado en muchos países. Por aprovechar la riqueza forestal para fines comerciales inmediatos, se devastaron inmensas regiones que no solo se han hecho estériles, sino que han sido transformadas en verdaderas amenazas para la economía nacional. Destructoras inundaciones en muchas partes del mundo, ilustran siniestramente esta realidad.

Sin embargo, existen industrias que, a la par que explotan los recursos naturales, crean nueva riqueza en el territorio en que se desarrollan, abriendo amplias fuentes de progreso y bienestar para el pueblo. La moderna industria del petróleo es típica de esta clasificación. Es una de las que más directamente han contribuído al progreso humano en los últimos cuarenta o cincuenta años. Durante el pasado cuarto de siglo ha realizado verdaderos milagros en las zonas más importantes de la América Latina. El generoso objetivo de promover una verdadera "buena voluntad" entre sus pueblos, no tiene mejor servidor que esta industria.

Deberá acentuarse la utilidad de su obra entre las naciones latinoamericanas en los años venideros, si el curso de su desarrollo normal no es retardado u obstruído por fuerzas artificiales y destructoras. Tal posibilidad es condenada por los mejores y más equilibrados espíritus del Continente, para quienes es cada día más evidente que hay pocas empresas inter-americanas en las cuales las posibilidades de cooperación práctica, constructiva y fructífera entre la América Latina y los Estados Unidos, tengan campo más extenso que en esta industria.

El acercamiento real entre las naciones

structive and fruitful cooperation between Latin America and the United States can have wider prospects than in this industry.

Genuine rapprochement among the American nations should be based on satisfactory and normal relations among their peoples, reciprocally collaborating for common progress and well-being. It requires practical and effective measures beneficially influencing life in the respective nations. Facts prove how effective a part the petroleum industry has had in the economic development of several Latin American countries. There, it has already realized formidable accomplishments and now it is summoned to even greater achievements. Almost unlimited is the radius of its stimulating influence throughout the national economy of which it constitutes an integral part. Although radically different policies have been pursued in the various major petroleum producing countries of the hemisphere, public opinion in all of them is beginning to realize how patent are certain basic facts upon which, sooner or later, must rest the complete and definite understanding of the Latin American industrial problem, in general, and the petroleum problem, particularly.

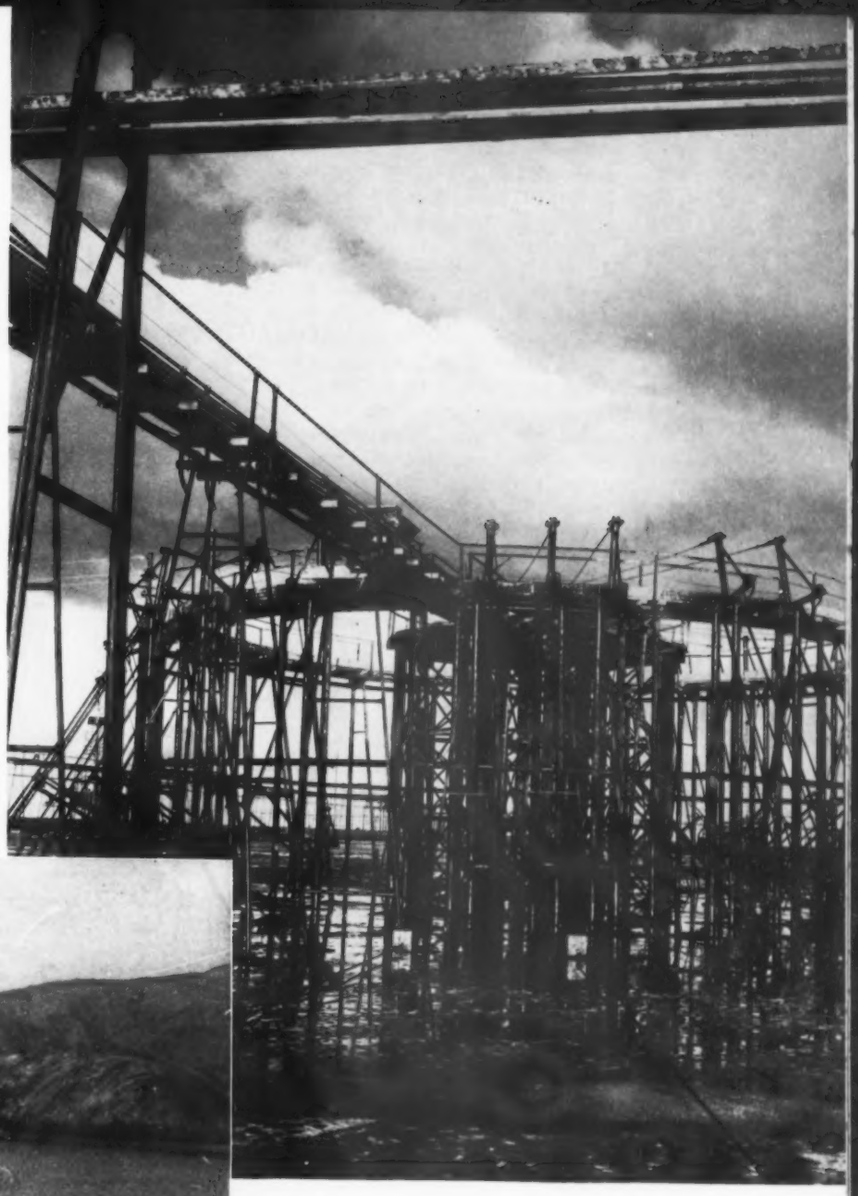
A mere glance at the world petroleum map reveals the enormous importance, present and future, of the natural riches so abundant in vast regions of Latin America. It is interesting to note that mineral oil is found in some of the most inhospitable zones, as if to compensate for the lack of fertility in the soil. This very characteristic of its field of operation has made this exploitation one of the most hazardous, costly and difficult of the modern world. From the very outset it demands a maximum cooperation from two of the most important factors in the progress of civilization: capital and technical ability.

The financial resources of Latin America are patently inadequate for supplying the enormous capital required by this industry. Foreign capital is absolutely necessary—just as it was for the development of the wealth of other great nations, the United States included. American capital already has shared in varying proportions in the exploitation of petroleum deposits throughout the Americas, particularly in Mexico, Bolivia, Venezuela, Colombia, Peru and Argentina. The function of American capital, indeed, has been decisive; in the future it will be irreplaceable. How can the unfortunate realities of the possible future of Europe be ignored? Even in countries which, like Mexico and Bolivia, have adopted policies of hostility and repression the most authoritative and important public officials express a desire to see more United States capital invested in their territories. In spite of inimical propaganda and the lack of educative information among the masses, the work

accomplished by foreign capital is beginning to be appreciated in all its true merit in Latin America. Among this capital, the part emanating from the United States—so frequently misrepresented—is obtaining a sincere and intelligent recognition. No single factor of "good will" could be more effective in Latin America.

continentales debe basarse en las relaciones satisfactorias y normales entre sus pueblos, en colaboración recíproca para el progreso y el bienestar común. Este requiere medidas prácticas y efectivas, de influencia beneficiosa en la vida de esas naciones. La realidad comprueba la parte tan eficaz que en el desarrollo económico de varias naciones latinoamericanas ha tenido la industria petrolera. Esta ha realizado ya allí una formidable obra y está llamada a mayores realizaciones aún. El radio de su influencia estimuladora de todos los sectores de la economía nacional de la que constituye parte integrante, es casi ilimitado. Aunque ha sido radicalmente diferente la política seguida en los varios países de gran producción petrolera del hemisferio, la opinión pública en todos ellos empieza a comprender cuán indiscutibles son ciertos hechos básicos sobre los cuales, tarde o temprano, ha de fundarse la comprensión completa y definitiva del problema industrial latinoamericano, en general; y en particular, del problema petrolero.

Una simple ojeada al mapa petrolero universal revela la enorme importancia, presente y futura, de esta riqueza natural tan abundante en gran parte de la América Latina. Es



Left, the oil camp at Talara, Peru, one of the early important fields to be developed in South America; Below, terminus of road and pipeline opening up an important new region in Eastern Venezuela — a ship unloading materials for road and pipeline construction; Multiple pumping unit on marine wells in the Comodoro Rivadavia field in Argentina.

interesante notar que el aceite mineral se encuentra en algunas de las más inhospitalarias zonas, como para compensarlas de la falta de riqueza del suelo. Mas esa misma característica de su campo de acción, ha hecho de esta explotación, una de las más arriesgadas, costosas y difíciles del mundo industrial moderno. Desde el primer paso demanda una cooperación máxima de dos de los más importantes factores en el progreso de la civilización: el capital y la pericia técnica.

Para las enormes exigencias de capital de esta industria, los recursos financieros de la América Latina son absolutamente inadecuados. Es totalmente imprescindible el capital extranjero—como lo fué para el desarrollo de la riqueza de otras grandes naciones, los Estados Unidos entre ellos—. El capital americano ha participado ya en proporción varia en la explotación de yacimientos petrolíferos en toda América; especialmente en México, Bolivia, Venezuela, Colombia, Perú, Argentina. La función del capital americano, ciertamente, ha sido decisiva; en el porvenir será insustituíble. ¿Cómo dejar de percibir las ingratas realidades del porvenir probable de Europa? Hasta en países que, como México y Bolivia, adoptaron una política de hostilidad y represión, los más autorizados representantes públicos expresan el anhelo de ver más capital de los Estados Unidos invertido en su territorio. A despecho de la propaganda hostil y de la falta de información educativa entre las masas, la obra del capital extranjero empieza a apreciarse en todo su valor en la América Latina. Y entre ese capital, la parte de los Estados Unidos—tan frecuentemente mal interpretada—obtiene ya un reconocimiento sincero e inteligente. Ningún factor de "buena voluntad" podria ser más eficaz en la América Latina.

To public opinion there, this is being daily confirmed by the incontestable lessons of reality. The absurd theory that foreign capital always means the destructive "exploitation" of the country in which it is invested and constitutes a threat to its independence, is already discredited. In the New World, itself, the example of Canada has persuasive eloquence. The United States has invested about $1,700,000,000 in this region of less population than either Brazil, Mexico or Argentina. The result has neither been a threat to the sovereignity of the dominion nor a destructive exploitation of its riches by American capital. The contrary is true. The present world situation serves to emphasize strongly the national personality of Canada, and its prosperity is revealed by the fact that with only 11,000,000 inhabitants it absorbs only a slightly smaller part of the exports of the United States than does all of Latin America and the West Indies combined, with a total population ten times greater than that of Canada.

Educated Latin Americans are convinced that without the cooperation of foreign capital, the universal desire to see an adequate and rapid development of the natural resources of those countries will be impossible. In Mexico the petroleum industry, financed by foreign capital paid salaries, in 1936, that were two to four times higher than the average salaries in industries managed by Mexicans. The country did not produce any petroleum whatsoever before 1900; its immense deposits lay unproductive and idle. In 1916 the industry had already acquired foremost importance. By 1918 Mexico was the second producing country in the world. In 1921 petroleum production reached its peak with a total of 193,398,000 bbl. From 1916 to 1927 this industry spent in Mexico alone, for salaries, taxes, transportation, and other expenses, an average of $81,000,000 annually.

Aside from constituting a vital support to the fiscal burdens of the government this new and formidable industry promoted general progress in a variety of ways. The buying power of the public increased rapidly. Fifty thousand Mexicans obtained employment in the industry. In their everyday existence several hundred thousand others in all walks of life were able to enjoy modern comforts, made accessible to them by the new commercial activity. Sanitation and public education received an effective impetus. The continued expansion of this progress was taken for granted while new foreign capital was expected to accelerate the rhythm by developing other natural resources. At this juncture a governmental policy adverse to foreign cooperation cut this cycle of improvement and progress.

A few figures show not only how foreign investments by developing new industries stimulate trade and create new wealth but also, how, when the investments are crippled, the prosperity of the country, its trade and general economy suffer.

During the decade prior to 1916, Mexico's imports from the United States averaged about $47,400,000. Between 1916 and 1921 oil production in Mexico was pushed intensively with a result that Mexico's imports from the United States rose from $53,266,000 in 1916 to $217,453,000 in 1921, when production reached its peak. From that moment on, governmental policies steadily cut down oil production until it reached its low of 32,805,000 bbl. in 1932. Correspondingly Mexico's imports from the United States in that year fell to only $30,996,000.

The present situation of the Mexican petroleum industry is fully known, and its relation to the general situation of the country need not be retold now.

Neither is this necessary, in the opposite sense, with regard to the conditions prevailing in Venezuela—another great petroleum producing country of Latin America. A government of sober, practical mentality and a constructive concept of national realities, is cooperating there with the petroleum industry —financed by outside capital — for the development of this great source of national wealth. Unhealthy regions in which development is being carried out are being rapidly transformed. Vast areas are being rendered habitable by the systematic extinction of epidemics which once infested them, and this work is hastened by the opening of roads, ports, hospitals and the adoption of all means for providing a sanitary and modern life to the people. Buying power has risen; local commercial activity has multiplied. The entire country has benefited from the new industry. A similar situation can be pointed out in corresponding regions of Colombia and Peru. Outside capital in each of these countries does not limit itself simply to obtaining riches already existent, but rather, in the process of exploitation, it creates new wealth which remains permanently incorporated into the economy of the nation. In fact, foreign investments are assimilated by the economy of the country through direct or indirect means, sooner or later. Each day, thus, the function performed by foreign capital employed in productive purposes, is made more evident to the dispassionate and intelligent opinion of Latin America.

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South American oilfield development involves much more than drilling and transporting oil; above, maintaining the dyke which keeps the waters of Maracaibo from flooding Lagunillas, and right port constructed on the Sardinata by South American Gulf to receive building materials for the Barco.

None the less evident, either, is the essential task performed by the technical aid applied for the development of the natural resources. In Latin America, this has a function which is absolutely essential, and which public opinion in those countries is beginning to understand and respect. This is one of the real bases for "good will."

Without foreign capital, and the technical experience which it makes available, the immense natural resources of Latin America would be condemned to unproductiveness for an indefinite time. National progress would be retarded in almost all aspects. Vast regions blessed with wealth to offer civilization for bettering the living conditions of countless millions—and to serve as a new foundation for the reorganized existence of persecuted populations in other lands—would continue practically unutilized. Foreign capital in today's world means only American capital; foreign technique implies American technical skill. In the eyes of new Latin American generations who consider the United States the richest, most powerful and most influential nation on earth—in peace now, and potentially in the future in war as well—this American capital and American technical skill do not have the old aspect of a phantom threatening their independence. Rather, they see the United States as a necessary and reasonable collaborator in the great work of recovering for the use of civilization and progress, the natural resources of the hemisphere.

However, in recent years this same American industrial system which has supplied capital and technical direction for the realization of almost all the great industrial advances in Latin America, and is the real, practical base for the rapprochement and "good will" among the American nations, has been declared a failure by propaganda. Conclusive data refute this accusation, but these falsities

En la opinión pública de allí lo afirman diariamente las lecciones incontestables de la realidad. La absurda teoría de que capital extranjero implica siempre la "explotación" destructora del país en el que se invierte y constituye una amenaza contra su independencia, está ya desacreditada. En el Nuevo Mundo mismo, el ejemplo del Canadá tiene persuasiva elocuencia. Los Estados Unidos han invertido en ese territorio, de menos población que el Brasil, México o la Argentina, cerca de $1.700.000.000. Y no ha resultado una amenaza para la soberanía nacional del Dominio, ni la "destructora" explotación de su riqueza por el capital americano. Todo lo contrario. La situación mundial presente destaca fuertemente la personalidad nacional canadiense; y su prosperidad nacional la revela el hecho de que, con once millones de habitantes, absorbe poco menor parte de las exportaciones de los Estados Unidos que la América Latina entera y las Antillas reunidas, con una población total diez veces mayor que la del Canadá.

Entre las clases educadas latinoamericanas se afirma ya la convicción de que sin la cooperación del capital extranjero, el anhelo unánime de ver desarrollados las recursos naturales de esos países adecuada y rápidamente será irrealizable.

En México la industria petrolífera financiada por capital extranjero pagaba en 1936 jornales de dos a cuatro veces superiores al jornal medio pagado por los industriales del país. Este no producía petróleo alguno antes de 1900; sus inmensos yacimientos eran improductivos y ociosos. En 1916 había adquirido ya importancia saliente. Para 1918 era ya México el segundo país productor del mundo. En 1921 la producción petrolera alcanzaba su máximo, con un total de 193.-398.000 de barriles. De 1916 a 1927 esta industria sola gastó en México, en salarios, contribuciones, transportes y otros gastos, un promedio de $81,000,000 anuales.

Aparte de que constituía un vital apoyo para el tesoro fiscal del gobierno, esta nueva y formidable industria, estimulaba el progreso general en varias formas. El poder adquisitivo del público, se elevó rápidamente. Cincuenta mil mexicanos obtuvieron empleo en la industria. Centenares de millares de mexicanos de todas las clases sociales podían gozar en su vida cotidiana de las comodidades de la existencia moderna, que hacía accesibles la nueva actividad comercial. La sanidad y la educación pública recibían impulso efectivo. La expansión del progreso alcanzado se descontaba ya, a medida que nuevos capitales extranjeros fueron intensificando el desenvolvimiento de otros recursos naturales. En ese punto, una política del gobierno adversa a la cooperación extranjera cortó sete ciclo de mejoras y progreso.

Unas cuantas cifras demuestran no solamente la forma en que las inversiones extranjeras, al desarrollar nuevas industrias, estimulan el comercio y crean nueva riqueza, sino también cómo cuando se reprime al capital extranjero, la prosperidad del país, su comercio y su economía en general, sufren igualmente.

Durante el decenio anterior a 1916, la importación mexicana de los Estados Unidos tenía un promedio anual de $47.400.000. Entre 1916 y 1921 la producción petrolera de México fué impulsada intensamente con el resultado de que las importaciones mexicanas de los Estados Unidos saltaron de $53.266.000 en 1916 a $217.453.000 en 1921, cuando la producción alcanzaba su máximo. Desde ese momento, la política del gobierno fué cortando constantemente la producción de petróleo hasta que llegó a su mínimo de 32.805.000 barriles en 1932. En correspondencia con esa cifra, la importación mexicana de los Estados Unidos en ese año cayó hasta $30.996.000.

La situación actual de la industria petrolera en México es harto conocida; y, en relación con la situación general del país, no necesita ser presentada ahora.

Tampoco es necesario hacerlo, en sentido, opuesto, con relación a la situación existente en Venezuela—otro gran país productor de petróleo de la América Latina—. Un gobierno de mentalidad sobria, y práctico y constructivo concepto de las realidades nacionales, coopera allí con la industria petrolífera—financiada por capital extranjero para el desarrollo de esta gran fuente de riqueza nacional. Las regiones insalubres en las cuales se lleva a cabo la explotación, están siendo rápidamente transformadas. Vastas extensiones están siendo hechas habitables por la sistemática extinción de las epidemias que las infestaban antes; y esta tarea se hace más rápida por la apertura de carreteras, puertos, hospitales y la adopción de toda clase de medios para proporcionar vida sanitaria y moderna a las masas populares. El poder adquisitivo de éstas se ha elevado; se ha multiplicado la actividad comercial. El país entero ha recibido beneficios de la nueva industria. Una similar situación puede indicarse en las zonas correspondientes de Colombia y el Perú. El capital extranjero en cada uno de esos países no se limita simplemente a explotar la riqueza ya existente, sino que antes bien, en ese proceso de explotación, crea nueva riqueza que queda ya permanentemente incorporada a la economía de la nación. De hecho, las inversiones extranjeras son asimiladas por la economía del país en que trabajan, por medios directos o indirectos, tarde o temprano. Cada día, así, se hace más evidente para la opinión desapasionada e inteligente de la América Latina, la función del capital extraño empleado productivamente allí.

No menos evidente es la tarea esencial que realiza la pericia técnica importada por los extranjeros, para colaborar en el desarrollo de los recursos naturales.

En la América Latina, ella tiene una función absolutamente esencial, que la opinión pública de esos países está comenzando a comprender y respetar. Esa es una de las más reales bases del "Good Will".

Sin capital extranjero y sin la pericia técnica que él hace posible, los inmensos recursos naturales de la América Latina estarían condenados a la improductividad por tiempo indefinido. El progreso nacional se retardaría casi en todos sus aspectos. Vastas zonas dotadas de riquezas que ofrecer a la civilización para mejorar las condiciones de vida de millones de personas—y para servir de nueva base a la existencia reorganizada de poblaciones perseguidas en otras tierras—continuarían prácticamente sin utilizar. El capital extranjero en el mundo del día, solo puede significar capital americano; técnica extranjera, implica habilidad técnica americana.

Almost every airtrip to South America carries oil men from field to headquarters and return.

are harmful to that very "good will" which the United States so sincerely desires to achieve in the Americas.

In fact from 1930 to 1938, this American industrial system, whose failure has been proclaimed, contributed nearly $9,000,000,000 towards the support of the government of the United States. During the five years of the crisis—from 1930 to 1934—American industry paid salaries, dividends, contributions, and the bill for raw materials and other matters to the tune of an astronomical figure $27,000,000,000 in excess of its gross income. Even in the depths of the economic depression American private industry sustained in employment some 40,000,000 workers of both sexes.

This same gigantic, progressive industrial organization which makes possible the prodigy of power and achievement which is North American civilization, has extended and must continue extending its financial resources and its technical inspiration throughout the rest of the continent. The success or failure of this movement—vital to the rapid and complete development of the Western Hemisphere—shall determine to a large extent the course of modern history.

The role which irrevocably is that of the United States in current history requires an effective and dynamic continental solidarity. In favor of this, at the Conference of Havana all of the nations to the south have just proclaimed themselves unanimously. Unmistakable proofs confirm this impression of Latin American sentiment. Yet, continental solidarity can only be a complete actuality when the relations between the United States and its sister republics are based on confidence and reciprocal respect.

Obviously no such confidence can exist where nations like Mexico and Bolivia antagonize foreign capital by abusing its rights and provoking situations like those suffered by the petroleum industry in those countries. It ought to be noted that such actions not only drive foreign capital from their respective territories, but they also discourage American capital from any possible expansion throughout the rest of Latin America. Capital justifiably fears that other nations may imitate the example of Mexico and Bolivia. It is not only in the interest of the United States that this policy of aggression be rectified and the abuses already committed be remedied. All of Latin America finds itself vitally interested in this rectification and reparation so that the essential reciprocal confidence may be reestablished in order that foreign capital may continue extending and intensifying its collaboration in the development of the natural resources of Latin America. Inasmuch as this foreign capital seeks no special privilege, it ought not be denied the right to demand equal and just treatment in the countries where it operates; that the governments of the countries, whose industries it is fomenting, respect its properties, its rights and its investments. Without these minimum guaranties capital will not venture further in Latin America and the development of its natural resources will be brought to a virtual standstill.

Speaking before the Pan American Conference at Havana, Secretary of State Hull described the international situation as the "culmination of a process of deterioration of international conduct and morality in various countries of the world, . . . ". Secretary Hull was referring to the "aggressor" nations; but the condemnation of the policy of breaking agreements and treaties, of conduct of violence, illegality and immorality on the part of nations as among individuals, is liable to a wider application. Continental solidarity must rest upon the respect of this doctrine under which alone can continued progress in the New World be assured, economically, industrially, culturally and spiritually. International morality implies national morality; the respect of treaties among nations presupposes the respect of contracts between governments and private individuals. To insist on this standard of international, national and private morality in the entire hemisphere will be the best guarantee that its solidarity is protected from internal dangers. It will not be possible to claim that any one nation, government or individual is favored by the strict compliance with the moral law inasmuch as it protects the weak as well as the strong, the large as well as the small, the wealthy as well as the poor.

The policy of the "Good Neighbor" practiced by the United States with profound good faith, in the unanimous opinion of Latin America, requires a complete reciprocity on the part of the other American nations. It is essential that all of them perform their obligations, agreements and contracts their governments ought to guarantee the maintenance of the rights of nationals and foreigners in their territories. In this regard, North American capital justly hopes for and requires the cooperation of the governments of Latin America. These nations cannot hope for the benefits of continental solidarity based on the cooperation of the United States unless they assure the United States a treatment embodying the equity and justice which is the key to progress and civilization.

Continental solidarity also requires an immediate sustained effort to eliminate the inequality now existing in the living standards among the nations of the hemisphere. The marked difference in the economic progress of some of them constitutes an obstacle to the normal course of commerce, to economic interchange, even to simple communication between one people and another. While countries of retarded progress lack adequate means of affording their citizens a modern existence, offering them a share of the advances of civilization enjoyed by the most progressive peoples of the hemisphere, continental solidarity cannot be definite. Such solidarity will not be possible in its full sense until the natural resources of all the American nations are put into productive use —gradually and reasonably accomplished. Experience shows that progress and wealth expand and penetrate even to the lowest grades of human society, once the utilization of a nation's resources is organized and continued. In order that this process should begin and develop, it is essential that in Latin American countries, foreign capital and technical ability should collaborate; that is to say, American capital and technique. Of this basic reality the representative opinion of Latin America is already convinced.

In this critical moment in the history of the world a function of supreme importance falls to the lot of capital and industry in the United States. In its charge is the practical, effective and permanent realization of the ideal of continental "good will", a universal aspiration in the Americas. It ought to be realized with deeds and not words; practical, reasonable, possible deeds; not with fantastic plans or projects without a really feasible base. It ought not be forgotten that economic progress is always reflected by the elevation of the standard of living in the respective countries, intellectually, morally and politically. Just as the political instability of one country impedes adequate economic cooperation from abroad so a fair and just recognition of mutual rights and responsibilities acts as a normalizing influence in its political life. Here again the duty of the capital and industry of the United States reveals its vital importance. The peace of the entire continent is always directly related to the degree of political normalcy within each individual country. Collaboration in economic development elevating the standard of living, accelerating progress and furthering the well-being of all citizens, will be a positive and eternal affirmation of the unity and greatness of the Western Hemisphere against the threat or danger of the future.

Para las nuevas generaciones latinoamericanas, que consideran a los Estados Unidos la más rica, poderosa e influyente nación de la tierra—en la paz, ahora, y potencialmente también en la guerra en el porvenir—ese capital americano y ese técnica americaná, no tienen ya el aspecto antiguo de fantasma amenazador de la independencia. Sino que ven a los Estados Unidos como un colaborador necesario y razonable en la gran tarea de reivindicar, para el uso de la civilización y el progreso, los recursos naturales del hemisferio.

Mas ese mismo sistema industrial americano, que ha proporcionado capital y técnica para realizar casi todos los grandes adelantos industriales en la América Latina, y que es la base real y práctica para el acercamiento y la "buena voluntad" entre las naciones americanas, ha sido declarado fracasado por la propaganda. Datos concluyentes refutan esa acusación, pero tales falsedades son perjudiciales para el mismo "Good Will" que los Estados Unidos desean tan sinceramente lograr en las otras dos Américas.

De hecho, este mismo sistema industrial americano cuyo fracaso se proclama, contribuyó de 1930 a 1938 casi nueve mil millones de dólares para el sostenimiento del gobierno de los Estados Unidos. Durante los cinco años de crisis—de 1930 a 1934—la industria americana pagó por concepto de sueldos, dividendos, contribuciones, compras de materias primas y otras atenciones, cerca de $27.000.000.000, en exceso de sus ingresos totales. Aún en lo más intenso de la depresión económica, la industria privada americana sostuvo en empleo unos cuarenta millones de trabajadores de ambos sexos.

Esa misma gigantesca, dinámica, progresista organización industrial que ha hecho posible el prodigio de poder y adelanto que es la civilización norteamericana, ha proyectado y debe continuar proyectando sus recursos financieros y la inspiración de sus técnicos por el resto del continente. El éxito o el fracaso de este movimiento—vital para el rápido y completo desenvolvimiento del Hemisferio Occidental—determinará, en gran parte, el curso de la historia contemporánea.

El rol que en ella corresponde irrevocablemente a los Estados Unidos, requiere una solidaridad continental efectiva y dinámica. En favor de ella, se acaban de pronunciar unánimes todas las naciones del Sur en la Conferencia de la Habana y pruebas inconfundibles del sentimiento latinoamericano en ese sentido confirman aquella impresión. Mas la solidaridad del continente solo puede ser completa y real cuando las relaciones entre la Unión y sus repúblicas hermanas estén basadas en la confianza y el respeto recíprocos.

Evidentemente, no podrá existir tal confianza mientras naciones como México y Bolivia hostilizan al capital extranjero, atropellando sus derechos y provocando situaciones como las que sufre la industria petrolera en esos países. Debe notarse que tales situaciones no solo expulsan al capital extranjero de sus territorios respectivos, sino que desaniman también al capital americano de toda posible expansión por el resto de la América Latina. El capital extranjero, justificadamente, teme que los ejemplos de México y Bolivia puedan ser imitados por otras naciones. No es solo de interés para los Estados Unidos que se rectifique esa política de agresión y que se reparen los atropellos ya realizados. La América Latina entera se halla interesada en esa rectificación y reparación, para que pueda restablecerse la confianza recíproca esencial para que el capital extranjero continúe extendiendo e intensificando su colaboración en el desenvolvimiento de los recursos naturales de la América Latina. Toda vez que el capital extranjero no aspire a privilegios especiales, no puede negársele el derecho a demandar equitativo y justo tratamiento en los países en los que actúa; a que los gobiernos de las naciones cuyas industrias está fomentando, respeten sus propiedades, sus derechos y sus inversiones. Sin estas garantías mínimas, el capital extranjero no se aventurará más en la América Latina y el desarrollo de los recursos naturales de ella quedará prácticamente estancado.

Hablando ante la Conferencia Pan Americana de la Habana, el secretario Hull describió la situación internacional como la "culminación de un proceso de deterioración de la conducta y la moralidad internacional . . . en varias partes del mundo". Referíase el secretario Hull a las naciones "agresoras"; pero la condenación de la política de violación de contratos y tratados, de la conducta de violencia, ilegalidad e inmoralidad, lo mismo de parte de naciones que de individuos, es susceptible de más extensa aplicación. La solidaridad continental debe basarse en el respeto a esta doctrina, a cuyo amparo únicamente podrá asegurarse en el Nuevo Mundo la continuidad del progreso económico, industrial, cultural y espiritual. La moralidad internacional implica moralidad nacional; el respeto a los tratados entre naciones, supone el respeto a los contratos entre gobiernos e individuos privados. Insistir en este *standard* de moralidad internacional, nacional y privada en el hemisferio entero, será la mejor garantía de que su solidaridad está a cubierto de peligros interiores. No será posible alegar que una nación, gobierno o individuo cualesquiera son favorecidos por el estricto cumplimiento de la ley moral, ya que ésta protege al débil como al fuerte, al grande como al pequeño, al rico como al pobre.

Lo política del "buen vecino", practicada por los Estados Unidos con profunda buena fé, en opinión unánime de la América Latina, exige una completa reciprocidad de parte de las demás naciones americanas. Es esencial que todas ellas cumplan sus obligaciones, compromisos y contratos; sus gobiernos deberán garantizar el mantenimiento de los derechos de nacionales y extranjeros en sus territorios. En este sentido, el capital norteamericano espera y requiere, justificadamente, la cooperación de los gobiernos de la América Latina. Esas naciones no pueden aspirar a los beneficios de la solidaridad continental, que se basa en la cooperacion economica de los Estados Unidos, a menos de asegurar a éstos un tratamiento de equidad y justicia que es clave del progreso y la civilización.

La solidaridad continental exigirá también un esfuerzo inmediato y sostenido para eliminar la desigualdad ahora existente en el nivel de vida entre las naciones del hemisferio. La marcada diferencia en el desenvolvimiento económico de algunas de ellas, constituye un obstáculo para el normal curso del comercio, del intercambio económico, hasta de la simple comunicación de pueblo a pueblo. Mientras existan países de progreso retardado carentes de medios para proporcionar a sus ciudadanos una existencia moderna, que les ofrezca participación en los adelantos de la civilización de que disfrutan los pueblos más progresistas del hemisferio, la solidaridad continental no podrá ser definitiva. No será ella posible en toda su plenitud hasta que se hayan puesto en utilización productiva—gradual y razonablemente realizada—los recursos naturales de todas las naciones americanas. La experiencia demuestra que el progreso y la riqueza se extienden y penetran hasta las últimas capas de la sociedad humana, una vez que se organiza y continúa la utilización de aquellos recursos. Mas para que ese proceso se inicie y desarrolle, es esencial que en los países latinoamericanos colaboren el capital y la técnica americanos. De esta realidad básica está ya convencida la opinión representativa de la América Latina.

Corresponde, en este momento crítico de la historia del mundo, una función de suprema importancia al capital y la industria de los Estados Unidos. Está a su cargo la realización práctica, efectiva y permanente de ese ideal de "buena voluntad" continental que es aspiracion unánime en las Américas. Debe realizarse con hechos y no con palabras; hechos prácticos, razonables, posibles; no con planes fantásticos o proyectos sin base realmente factible. No debe olvidarse que el progreso económico se refleja siempre en la elevación del nivel de vida intelectual, moral, político en los países. Así como la inestabilidad política en un país impide la adecuada cooperación económica del exterior, un justo y equitativo reconocimiento de los derechos y responsabilidades mutuos, actúa como influencia normalizadora en su vida política. Y de nuevo en este aspecto la misión del capital y la industria de los Estados Unidos revela su importancia vital. La paz del continente entero está siempre directamente relacionada con el grado de normalidad política de cada una de sus naciones. La colaboración en el desenvolvimiento económico de esos países, en la elevación del nivel de vida, en la aceleración del progreso y en la intensificación del bienestar de sus ciudadanos, será una categórica y permanente afirmación de la unidad y la grandeza del Hemisferio Occidental—contra las amenazas o peligros del futuro.

Petroleum's Place In VENEZUELAN ECONOMY

By Dr. Manuel R. Egana
Minister of Fomento

CARACAS, VENEZUELA

THE petroleum industry affects the economy of Venezuela through the spending and investments of the companies which are exploiting crude oil in Venezuela. During the past three years the quantity of bills of exchange sold to the Oficina Nacional de Centralizacion de Cambios averaged Bs. 223,000,000 ($63,700,000) annually, in round numbers, which when added to what was obtained by the sale of products refined in the country reached the sum of Bs. 231,000,000 ($66,000,000). Of this amount Bs. 105,000,000 ($30,000,000) were collected by the national treasury in the form of taxes and duties; the difference, Bs. 126,000,000 ($36,000,000) or Bs. 4.30 per metric ton, were expended in the form of wages, salaries, purchases of materials and services in the country.

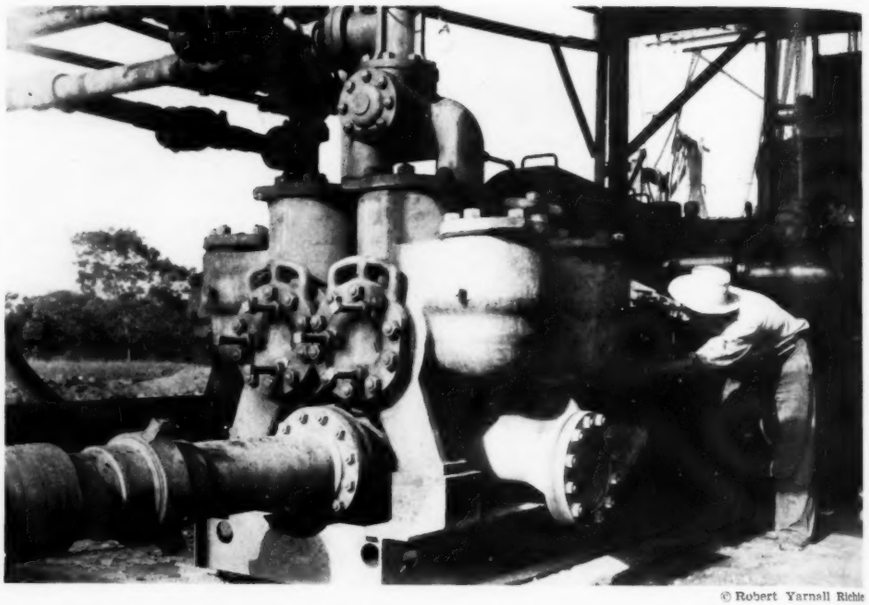
The benefits which the country derives from the activity of the petroleum industry therefore are of two kinds:

1. The taxes paid to the treasury. This income is new wealth created by the petroleum industry—the valorization of hydrocarbons existing in the subsoil—and is wealth which could not be exploited before the industry had developed.
2. The wages, salaries, etc., paid by the industry which represent the services which the country exports in the form of crude petroleum. The labor force necessary for creating these services exists independently of the petroleum industry, but its actual productivity, measured in terms of bolivars available for foreign exchange, is much superior, possibly more than twice, to what it would be if employed in the rest of our economic activities. The petroleum industry has created new wealth for the country in the same measure as this productivity has increased.

The total amount of spending in bolivars, roughly figured, is more than a fourth of the national income which is payable in bolivars, and if account be taken of the difference in purchasing power of the bolivar in foreign trade and the bolivar in domestic trade, the proportion will reach a third of the total national income.

Severe fluctuations in one major portion of the national income, with its inevitable repercussion on the rest of the country's economics is the price which we have to pay for the advantages obtained through the development of the petroleum industry, always under the condition that the fluctuations are occasioned only by variations in the international economic situation. The concentration of interest in the production of hydrocarbons in Venezuela has been, virtually, in the hands of the directing executives of a few corporations, and therefore a great responsibility is involved in the decisions of these directors.

It is difficult to find an example of an economic activity which is more evidently bound up with the public interest than the petroleum industry in Venezuela. On the one hand, the importance which it has acquired, (an importance which is not equalled in any other part of the world and in no other industry) and on the other hand the concentration of its control in a small group of interests, put these industrial activities in a special category. The state not only has the right but it also has the duty to regulate them so as to protect the interests of the Venezuelan community.



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Slush pumps on an Eastern Venezuela wildcat: discoveries during recent years in Eastern Venezuela assures that country of adequate reserves for years to come

The public interest which is involved in petroleum activities in Venezuela is vast and complex. Without doubt it calls for a systemization which in general outline may be regarded as consisting of:

1. Assuring to the industry a continuous development and a stable future, stimulating its activities in the following directions:
   (a) Development of the fields which produce marketable petroleum;
   (b) Development of refining in the country for the purposes of exportation;
   (c) Investigation into the technical and economic possibilities of releasing within the country the residual products; the coke and the heavy tar obtained when the crude oils are submitted to a process of intensive cracking. Venezuela has great deposits of iron minerals. The combination of iron metallurgy with the refining of heavy crudes on a large scale would valorize those deposits and increase the yield of the worthwhile products which it is possible economically to obtain from the heavy crudes.
   (d) Intensification of a foreign commercial policy in order to preserve the markets in which these products are sold.
2. Obtaining from the activities of the petroleum industry the maximum of benefits for Venezuela, in consonance with the just and equitable reward which all private capital invested in industrial activities should receive.
   (a) Consolidating in a more stable form the advantages obtained in recent years for the stabilization of our money near its gold parity.
   (b) Encouraging the reinvestment in the country of the profits and the benefits obtained by foreign capital in a form that will assist the economic development of Venezuela.
   (c) Reforming the taxes and duties which affect or may affect this industry so as to give them a more flexible form, and which may be automatically adjusted to the economic eventualities through which the industry may pass.
3. Avoiding so far as is possible, the violent fluctuations in the expenditures which the industry makes in Venezuela, expenditures which directly affect an appreciable part of our economic industries, and indirectly all the rest of them.
   (a) Stimulating and facilitating new investments in epochs of uncertainty and crisis.
   (b) Restraining and controlling violent expansions of the industry during speculative epochs.
   (c) Taking the necessary measures for controlling any possible abuse of economic power which the directors of this great industry can exercise over Venezuela.

Intra-Hemisphere COMMERCE And PROSPERITY Dependent on Better Understanding

By J. E. Brantly

IMPORTANCE OF LATIN AMERICAN and ANGLO-AMERICAN RELATIONS

To THE southward of the United States of America there lies a great area comprising somewhat more than 8,000,000 sq. miles of land and containing twenty sovereign nations, which we generally refer to under the inclusive term "Latin America". One of these countries the Repubic of Mexico, directly adjoins the southern boundary of the United States and six others lie to the southeastward in that narrow land area called Central America, which lies between the Isthmus of Tehuantepec and the Isthmus of Panama. Another ten countries occupy all of continental South America with the exception of the British, Dutch and French Guianas. Of the remaining three nations of the twenty, the Republic of Cuba occupies the island of the same name and the Republic of Haiti and the Dominican Republic occupy jointly the Island of Hispaniola.

These countries vary in size from the United States of Brazil with its more than three million square miles of territory and forty or more millions of people, to tiny Haiti with its ten thousand square miles of gloriously beautiful mountain terrain and three million inhabitants.

Of the entire estimated 115,000,000 or more people of these twenty nations, some 60,000,000 speak Spanish and 40,000,000 speak Portuguese. Of the remainder, 10,000,000 use various Indian dialects and live principally in the Spanish-speaking countries. The 3,000,000 Haitians employ French as their mother tongue.

Of these 115,000,000 of people in Latin America some 35,000,000 are of pure European stock and 20,000,000 are of original Indian blood. The Mestizoes, people of mixed white and Indian blood, compose an additional 40,000,000 and the remaining 20,000,000 are of pure Negro blood and mulattoes.

CLIMATE

As would be logically supposed all possible varieties of climate exist within this great region; from the frigid tops of a few isolated peaks in Mexico and Central America and the great ranges of perpetual snow on the high crests of the Andes to the hot jungle-covered lands within the Tropics. The arid and semi-arid deserts of northern Mexico and of the great central plateau of the same country, the

Workmen leaving El Centro for a weekly trip to Barranca Bermeja in Colombia's Magdalena Valley.

hot semi-arid areas of northwestern and northeastern Venezuela, the cool coastal strip of Peru and northern Chile, the plateau country of Peru, Bolivia and northwestern Argentina and the plains of Patagonia are offset in their barrenness by the dense jungle growths of the Tierra Caliente or hot country of Mexico and Central America and the southern parts of the Magdalena and Maracaibo Basins. The southern half of the Orinoco Basin and the great basin of the Amazon and its tributaries compose the greatest of all unbroken, hot, humid jungle forests. Brazil also has hot, dry country near the coast to the westward and northwestward of Natal. The rainfall of these deserts and jungles varies from zero—actually zero—in southern Peru and northern Chile along the Pacific Seaboard, to some 200 in. in parts of the Amazon Basin and Central America, where the warm, moisture laden clouds drifting in on the trade winds reach the cooling air of the forest and mountains and precipitate their water burden.

The plateaus and high mountain valleys and the coastal strips along the Atlantic and the Pacific oceans and the islands of the West Indies, offer the most salubrious climates for the white man. There is another vast and virtually undeveloped upland region of Central Brazil that offers a congenial tropical to sub-tropical climate.

The low tropical sections of Latin America are hot and sultry and not conducive to the most comfortable life for either the white man or the Indian. The Negro thrives. However, it is possible for the American or the European to live there quite comfortably and happily, but he must first adjust himself mentally and physically to the conditions to be found and regulate his mode of life to accord with the requirements of the region, as the white men of Latin America have done. In the high

Above, a government building in Bahia, Brazil, where the authorities have framed laws that confine ownership of any petroleum enterprise to nationals: left, a ranch on the upper Amazon Valley, now reasonably near a potential supply of Eastern Peruvian petroleum.

tropics the climate is healthful and delightful and to many, ideal. These mountainous terrains and high plateaus are quite unsurpassed in their scenic beauty and grandeur. In the temperate zones of northern Mexico and southern South America the conditions are no different from equivalent latitudes of the North American continent.

GEOGRAPHY

The mountain systems of Latin America extend from the boundary between Mexico and the United States, southeasterly through Mexico, Central America and on to continental South America in northwestern Colombia and thence in a southerly direction parallel to and near the Pacific Coast to the southernmost tip of the continent. A great mountain system likewise extends from Colombia in an easterly direction across northern Venezuela to Trinidad and thence northward along the Windward and Leeward Islands, northwestward across the Virgin Islands, Porto Rico, Hispaniola and Cuba, and thence southwesterly along the Caribbean Coast of Yucatan, through British Honduras and Guatamela to a junction with the primary ranges. This mountain system, which almost encircles the deeps of the Caribbean, is more ancient than that from Guatamela to Colombia and is really a part of the great Andes-Rocky Mountain chain. Between the Sierra Madre of the west and the Sierra Madre of the east of Mexico there lies the broad central plateau of that country and a narrow strip of lowlands and plains

extends from the lower basin of the Rio Grande to Yucatan. Thence on through Central America the terrain is entirely mountainous except for narrow coastal strips, to northern Colombia which has a generally low terrain with scattered mountain groups.

Beginning with southern Trinidad and extending westerly between the Orinoco River and the Andes mountain system to the north, there is a great, low, relatively unbroken country which continues southwesterly through eastern Colombia, eastern Ecuador, eastern Peru, extreme western Brazil, eastern Bolivia, and thence extending in a southerly direction through southeastern Bolivia and Paraguay and including all of the Argentine Republic east of the Andes mountain system. In Venezuela and southeastern Colombia this great valley is generally open plains country of relatively low rainfall and hence, poorly wooded. From southeastern Colombia to southern Bolivia the continental feature is covered by a dense tropical jungle cut by numerous navigable streams. In southern Bolivia and western Paraguay and parts of northern Argentina the famous wet savannah country, called the Chaco, is found. The remainder of this great central valley is occupied by the Pampas and plains country of central and northern Argentina. The barren plains of Patagonia compose the southern extremity which occupies the lower third of the Argentine Republic. Lying between the northern two-thirds of this north-south valley and the Atlantic Ocean is the Brazilian Landshield which is composed of the mountainous terrain of northern Guayana, the great Amazon Basin and the broken plateau country of central, eastern and southern Brazil. A narrow coastal plain lies between the Andes and the Pacific from Guayaquil, Ecuador, to Lima, Peru. There is likewise a low coastal plain extending along the coast of Brazil from latitude twenty south to the Amazon Basin. Adding the Magdalena Basin and the Maracaibo Lake Basin the principal topographic features of Latin America have been named.

GEOLOGY

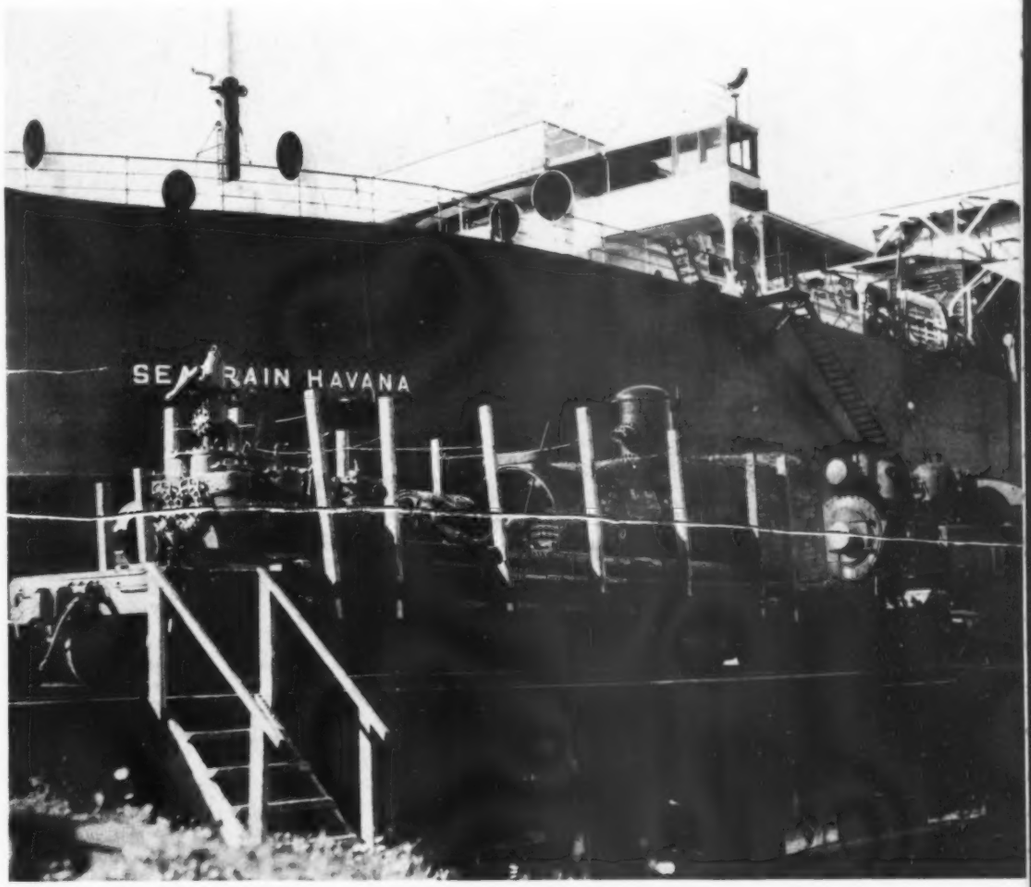
That region of South America, limited on the north by the Orinoco River, on the west and south by the great central valley and on the east by the Atlantic Ocean, is occupied principally by the Brazilian Landshield of Pre-Cambrian rocks, equivalent in age to the eastern half of the Appalachian Mountains and the Piedmont section of the eastern United States and the Laurentian Landshield of Canada. The Amazon Basin, which lies almost wholly within the old Landshield, is of very ancient origin and contains Paleozoic to Recent sediments. Mesozoic strata are known in southern Brazil and along the coastal strip in eastern Brazil and Tertiary formations are found in the southern Amazon Basin and along the coast line. The great central valley which is synclinal, is occupied insofar as is now known by Mesozoic and Tertiary strata. The Andes mountain system, involving various periods of folding as late as middle Tertiary, is composed of highly folded and metamorphosed sediments varying from Cambrian to lower Tertiary in age as well as great areas and mountains of old metamorphic and igneous rocks. From Colombia to Guatamela the formations are largely the later sediments and igneous rocks. In and northward of Guatamela sediments varying in age from early Paleozoic to middle Tertiary are involved. Northwestward to the border with the United States there are many occurrences of Paleozoic rocks and the great Sierra Madre of the east is supported primarily by Mesozoic limestones. The central plateau of Mexico is built largely of igneous and metamorphic rocks. The Gulf Coastal plain of Mexico and the Pacific Coastal plain of Peru involve Tertiary beds on the surface which are generally underlain by Mesozoic formations.

Compared to the continent of North American the Paleozoic Era is rather poorly represented. The ancient Brazilian Landshield is the primary source of the sediments of the central synclinal valley and of the sediments of the Andes mountain system.

MINERALS

A geologist or mining engineer would naturally and correctly suppose that the mountain system extending from the northern limits of Mexico to the tip of South America bears a great wealth of mineral resources, for these mountains are built of a contortion of ancient and sedimentary rocks, all cut by relatively recent igneous extrusions and intrusions. Thus there is a great abundance of those conditions which promote the deposition of important minerals in recoverable quantities. In Mexico there are large deposits of silver, lead, copper, gold, mercury, iron and many other valuable minerals, and in South America the rocks of the Andes mountain system carry gold, silver, platinum, precious stones, copper, tin, manganese, iron and many other minerals and metals of commercial importance. The ancient rocks of the Brazilian Landshield which include those of northern Guayana are likewise highly mineralized and yield ores of gold, copper, manganese, aluminum, lead, silver, mercury, nickel, tin, and many others. Brazil is the principal source of black diamonds or carbons, while the crystal diamonds are likewise found in relative abundance. What are without doubt the greatest deposits of iron ore in the world are in this country.

In many of the countries there have been great developments of some of these mineral deposits; however, the nature of the terrain and the isolation of the greater parts of the regions of possibility have limited the search



Shipping drilling equipment to Cuba: increased attention has recently been turned to oil prospecting in the West Indies.

for commercial ores to the more accessible areas of probable occurrence. Prospecting in dense tropical jungles and among high, dry mountains is difficult to say the least, and therefore vast territories in and around the periphery of the Amazon Basin and in the Andes have not been studied.

PETROLEUM

Gulf Coastal Mexico as an oil producing territory is well known and needs no comment other than the suggestion that there is logical reason to believe that great deposits of oil exist as yet undiscovered. Many of the relatively small sedimentary areas of Central American undoubtedly have possibilities of production while the Magdalena Basin and the Maracaibo Basin have been extensively drilled and are now producing large quantities of oil. Southern Trinidad has been producing oil for many years while in eastern Venezuela immense oilfields have been discovered within the past few years. It seems highly probable that the source of the greater part of the oil of Mexico, Colombia and Venezuela is in Mesozoic strata, principally Cretaceous. The great central valley, which is a vast geosyncline lying between the Andes Mountain System and the Brazilian Landshield, is known to be underlain by these same Mesozoic formations. Many seepages are known to occur in the eastern parts of Colombia, Ecuador, Peru and Bolivia, and an oilfield of substantial size was recently discovered in the Amazon Basin of Peru. There are other known deposits in southern Bolivia. The Argentine has oilfields near Salta in the northern part of the country, near Mendosa, in Neuquen in the westcentral part, and at Comodoro Rivadavia on the Atlantic Coast in the extreme southern part of the country. Thus we find large oilfields from one end of this great central valley to the other wherever thorough prospecting, including drilling, has been undertaken. It seems probable that the unexplored parts of this elongated basis compose one of, if not the greatest, petroleum reservoir areas yet to be developed in the world.

Successful wildcat in Eastern Peru drilled by Ganzo Azul: logical outlet for this oil would be in Western Brazil but as yet none is being shipped.

Oil is being produced in substantial quantities along the maritime strip of Ecuador and Peru, and the coastal strip of Brazil though averaging little more than twenty miles in width has definite possibilities of substantial production; three wells have been completed within the past few months within the city limits of Salvador, State of Bahia. There are likewise other areas of possibility in South America such as southern Brazil, parts of the lower Amazon Basin, and the coastal strip of the British and Dutch Guianas. The islands of Cuba and Hispaniola have a little production and greater possibilities.

WATER POWER

The combinations of mountainous and rugged topography, snow in the high Andes and heavy rainfall in the eastern foothills of the Andes, the Amazon Basin and the basins of other rivers heading on the Brazilian Landshield and in the Guayana, give to South America what is without question by far the predominating position in water power resources of any of the continents. The Amazon River alone carries nearly one-half of all the fresh water of the world that is introduced from the lands to the seas and most of the tributary streams of this river system are sourced in upland countries. They flow northward from the Brazilian Landshield, northeastward, eastward, and southeastward from the foothills of the Andes and southward from the mountains of the Guayanas. On each of many of these streams in excess of 1,000,000 h.p. can be developed, and there are hundreds of such streams. There are great cataracts on many tributary streams flowing northward into the Orinoco and from the inland country of the Guayana into the Atlantic. One of the greatest falls in the world is on the Rio Iguassũ between Brazil and Argentina near the confluence of this river with the Parana, and there are many other large streams with steep gradients flowing from the upland country into the system of the Rio de la Plata. The Magdalena River system of Colombia is not without potential water power, while many streams which are sourced in the snow-capped mountains of the Andes and flow westward into the Pacific have possibilities of substantial power development.

FORESTS

The basin of the Amazon River system is covered almost without break by dense, tropical jungles composed of commercially valuable hardwoods, trees yielding useful gums and many others producing nuts, oils, and abundant other useful products. Many trees, shrubs and herbs of this region yield materials that are valuable for medicinal purposes and in industrial chemistry. A generation ago a legion of rubber cruisers recruited from all the nations of the world traveled the innumerable navigable streams of the Amazon system and searched the nearby jungles for the trees which yielded the gum rubber of commerce. The once great city of Mañaos at the mouth of the Rio Negro in the Amazon and about one thousand miles upstream from the sea, was built by these jungle buccaneers as their capital. The small Indian village of Iquitos, situated on a high bluff above the mighty Amazon and twelve hundred miles farther up the river, was developed as the outlying capital of the industry. Many villages along the major and subsidiary streams served as local markets where the Indians and others could dispose of their harvest and purchase their simple requirements. Palatial river

steamers navigated these rivers, collected the products of the jungle and delivered them to Iquitos and Mañaos. These two river cities were regular ports of call then, as they are now, for ocean going steamers, the ultimate destination of which may have been New York or London.

Thoroughly understanding the importance of rubber and looking into the future as well as the then present, the thrifty Dutch transported rubber plants to the East Indian Islands under their control, where, together with British Malaysia, the great rubber industry was developed and taken away from Brazil, Colombia, Ecuador and Peru. Now with the Ford plantation on a tributary stream in the lower part of the Amazon valley, the industry is returning to Brazil. Other interests are likewise considering the original home of the rubber tree as a future source of the commodity, and it may be that in the not distant future American requirements will be loaded at Para instead of at a port in the East Indies. Certainly this is possible and probably logical or even necessary if new owners acquire the East Indian islands.

Other tropical jungles of equal or even greater importance, compared to the area, are those of southern Mexico, Central America, Pacific Coastal Ecuador and Colombia and the Magdalena and Maracaibo Basins. The Guayana is likewise rich in jungle lands and may be logically included with the Amazon and Orinoco Basins, for they compose one unbroken forested terrain.

AGRICULTURE

The twenty countries of Latin America are almost entirely self-sufficient agriculturally, though each of them finds it necessary to import certain products for which their soils or their climates are unsuited or which they are incapable of producing in adequate quantities. Were the plane of living of the masses higher, then more imports would be necessary. Most of the countries have exportable surpluses of some crops, through which they obtain the foreign exchange for the purchase of their other requirements. Colombia exports coffee and bananas; Venezuela ships coffee and cacao; coffee, cacao and quinine are sold by Ecuador, and sugar and cotton by Peru. Coffee, cotton, sugar and meat products are produced for export by Brazil. Argentina, Paraguay and Uruguay are exporters of beef, while the Argentine likewise has a great exportable surplus of wheat, corn, wool and mutton.

The arable soils of Mexico and Central America are confined principally to the dry upland plateaus and the mountain valleys where irrigation is necessary. In the hot lowlands sugar and bananas are grown. The agriculture of Venezuela is likewise confined to the upper dry plateaus and mountain valleys, with cattle raised principally on the plains of the great central valley to the north of the Orinoco River. Colombia grows bananas and some sugar along the Caribbean while its principal products of coffee and tobacco are raised on the mountain slopes and in the high mountain valleys. The grasslands of eastern Colombia are important pastures. The agricultural pursuits of Ecuador are confined almost entirely to the well-watered mountains and valleys. The stream valleys of the Pacific coastal plain of Peru, watered by streams sourced in the snow-capped Andes, compose the most important agricultural areas of the country. Other crops are grown in the high plateau country and some of the valleys and hillsides on the eastern flank of the Andes where the drainage is into the Amazon Basin, are cultivated. There are enormous areas in the well-watered, low mountains on this eastern flank of the Andean system in Colombia, Ecuador, Peru and Bolivia, which offer abundant possibilities for agricultural development.

Before drilling can start it is necessary to ship in materials for the construction of a complete camp.

The agricultural development of Brazil is confined almost entirely to a strip along the Atlantic seaboard, widening considerably, in the southern part of the country. The great Amazon Basin is almost devoid of soil cultivation. This is not due entirely to the climate and jungle growth but partly to the fact that the soils are not generally fertile even though they are of delta formation. Tropical river deltas and valleys are usually considered to be of the highest fertility but this is not always the case, and while the Amazon Basin has vast areas of very fertile, arable soil there are also great areas that are not suited to agricultural development. The lack of fertility is due to the nature of the materials deposited, which to a very considerable extent have been derived from the upper Andes and from the sedimentary beds along the flank of the Andes and to the fact that they are leached of plant food by the abundant rainfall. The rains also render the low, flat lands difficult of proper drainage. The central plateau of Brazil which affords a very fine example of mature topography offers excellent climatic conditions and good soils derived from the decomposition of the ancient rocks. This very large area of the country is undoubtedly capable of high agricultural development and it is abundantly rich in water power, mineral and forest resources.

The greatest areas of rich agricultural lands on the continent are in the northern two-thirds of the Argentine and in Uruguay and southern Brazil. The soils of these lands and their development are unsurpassed in any part of the Western Hemisphere.

Considered as a whole the 8,000,000 sq. mi. of Latin America could support a much greater population than its present 115,000,000. There are no means for obtaining accurate detailed information on the subject, but it may be stated with approximate accuracy that no more than a third of the fertile, arable soil of the region is now under reasonably intensive cultivation.

CULTURE

The Spanish and Portuguese people who first came to the Western Hemisphere were of three classes, which in order of dominance were, first, the officers of the Army and Navy and other representative of the crowned heads of the parent nations; second, the representatives of the Holy Catholic Church of Rome, who were priests and members of various religious orders; and third, the soldiers and sailors. The first of these were representatives of the cultural and social flower of their nations and included the direct representatives and envoys of the crowns. They brought to the new world the customs, ideals and ideas of the Iberian Peninsula and from them have descended and been developed those characteristics and traits of the present upper classes. Generally these men were accompanied by or followed by their families, thus establishing the culture and social customs of their homeland in the Western Hemisphere at a very early date.

The representatives of the Church in their various capacities were responsible for the spiritual welfare of all classes, the conversion of the natives to the beliefs of the Church and the instruction of the children of the upper classes. They were also the secretaries and clerks in the early days and were responsible for the histories and chronicles of the conquests and explorations, and later of the colonial empire.

The soldiers and the sailors were representatives of a lower social and economic order in the mother countries and usually continued in the same relative class in the new provinces. These men were generally unable to supply funds necessary to transport their families from Europe to the new world and in consequence they sought their female companions among the native Indians. It is from these white fathers and Indian mothers that the great mixed peoples of most of the Latin American countries are descended.

Between these three classes of newcomers the native inhabitants received rather harsh treatment; their governments were destroyed, their lands were confiscated and their temples were torn down and the materials used to build the white man's cathedrals. New religious beliefs were forced upon them and their bodies were placed in virtual slavery. Such was the foundation of the Spanish American civilization, and for that matter of the Anglo-American civilization as well. But one cannot be too harsh and condemn too readily, for such conquests were the customs of the times, and even now modern warfare has little to learn from the conquests of North and South America.

The early Portuguese and Spaniards found that the humid, hot countries did not offer climates conducive to large Indian populations and that those who were there were intractable and declined to be harnessed as the white man's slaves. In consequence vast numbers of negroes were imported from Africa and were settled in the low countries of Central America, Colombia, the Caribbean Islands, the Guianas, and particularly in coastal Brazil.

The original expeditions were sent out from Portugal and Spain to the New World not for the purpose of colonizing new lands or to allow freedom of political or religious beliefs but entirely in search of gold, silver, precious stones, spices, rare woods, and such other objects that were valued and appreciated in the homeland. After the soldiers and priests had established some degree of order and had completed their gathering of the mined gold and silver which were the original and primary objects of their search, the traders and merchants came, and all manner of people except the skilled and common workman and peasants. They could not compete with the serf and slave labor.

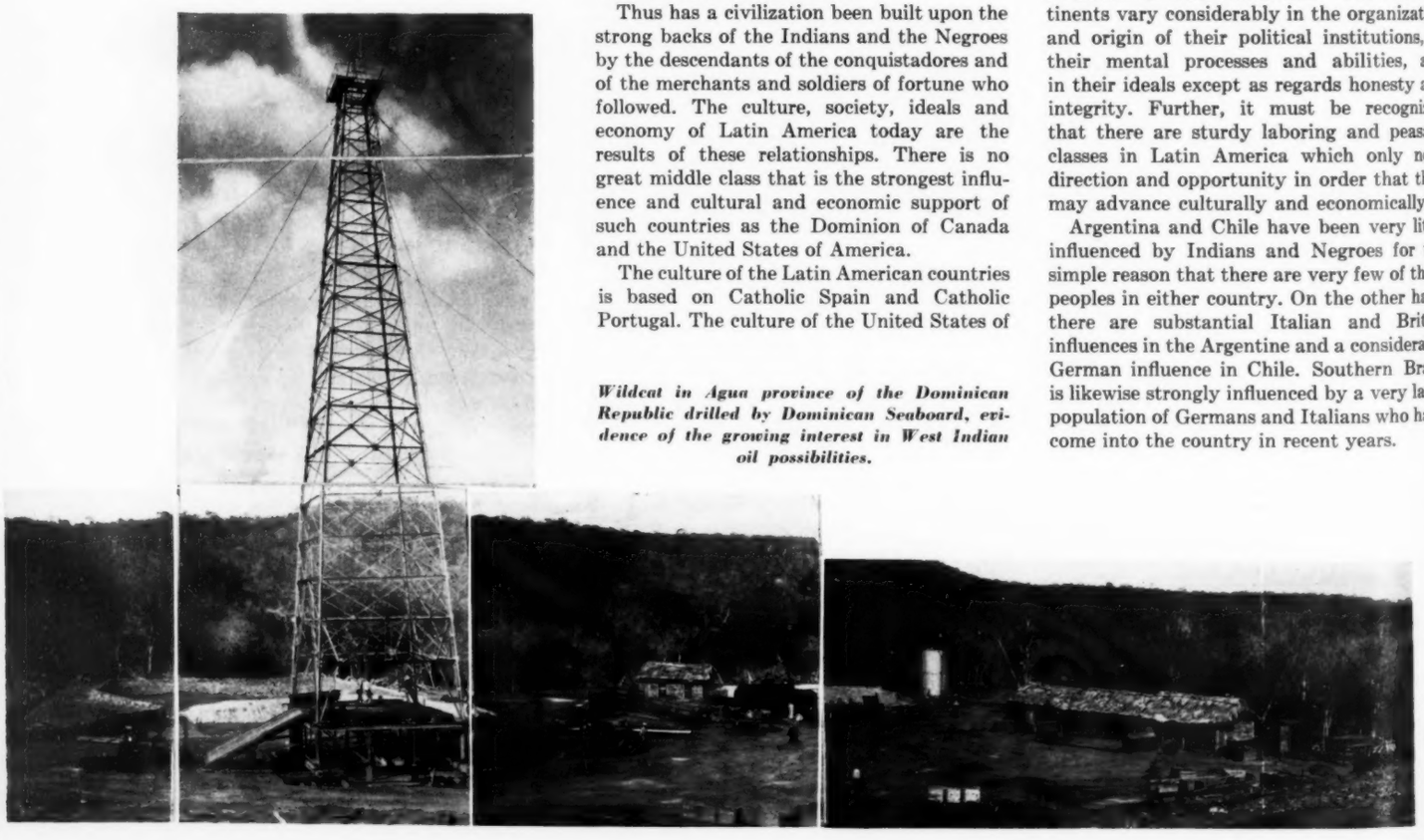
Thus has a civilization been built upon the strong backs of the Indians and the Negroes by the descendants of the conquistadores and of the merchants and soldiers of fortune who followed. The culture, society, ideals and economy of Latin America today are the results of these relationships. There is no great middle class that is the strongest influence and cultural and economic support of such countries as the Dominion of Canada and the United States of America.

The culture of the Latin American countries is based on Catholic Spain and Catholic Portugal. The culture of the United States of America and the Dominion of Canada is based on Protestant Britain. Also both the Indian and the Negro have had vast cultural influences in all of the Latin American countries in which they exist in substantial numbers, both on their own account and through the customs evolved because of their existence there. The same statement may be made of the southeastern part of the United States.

Since the laboring and peasant class of Spain and Portugal did not come to the Western Hemisphere in other than very small numbers and having Indians and Negroes to perform the manual tasks, the upperclass of white men have never learned to work with their hands. Hence, when a young man receives an engineering degree from a university or college he expects and gets a position of some authority immediately and never goes lower in the scale. This is most unfortunate, for we know that college training is only a part of the necessary education of an engineer and that he must later learn to do with his hands those things which in the future he would direct with his head.

Thus have the two societies of Anglo-American and Latin America developed along divergent lines, resulting in a lack of understanding of the social and cultural customs of one by the other. In the past contacts between the two have been relatively few for both have looked to Europe for intellectual relationships. The time has now arrived when new associations and relationships are essential to the welfare of the two Americas, and the considerations for the perfection of such associations and relationships must be based upon the fact that the peoples of the upper social and economic strata of Latin America are descended from forebears of an honorable, cultured class and they have remained an honorable, cultured class; but their culture is based on Spain and Portugal and Catholicism, while that of Anglo-American is based on Britain and Protestantism. The two continents vary considerably in the organization and origin of their political institutions, in their mental processes and abilities, and in their ideals except as regards honesty and integrity. Further, it must be recognized that there are sturdy laboring and peasant classes in Latin America which only need direction and opportunity in order that they may advance culturally and economically.

Argentina and Chile have been very little influenced by Indians and Negroes for the simple reason that there are very few of these peoples in either country. On the other hand there are substantial Italian and British influences in the Argentine and a considerable German influence in Chile. Southern Brazil is likewise strongly influenced by a very large population of Germans and Italians who have come into the country in recent years.



Wildcat in Agua province of the Dominican Republic drilled by Dominican Seaboard, evidence of the growing interest in West Indian oil possibilities.

GOVERNMENTS

All of the Latin American countries are republics and generally known as democratic republics, though actually the control of the governments is in most of these countries confined to a definite class of people and not to the entire population. Changes of government do not come about by the use of the ballot entirely, but by the increase or decrease in strength of a given faction of the controlling class. The Latin American governments unquestionably are more suited to the requirements of their people than would be the type maintained in the United States or Canada. In government they are pragmatists.

DEVELOPMENT

The development and economic progress of the Latin American countries has been influenced by several factors, among which are the cultural and economic principles inherited from the peoples from whom the dominating and controlling classes are derived, the great cultural and economic space separating the upper class and lower class and the absence of a substantial, consuming middle class. The limitations of the lower class of people and undoubtedly the physical character of the countries including the topography, soil and climate have played most important parts.

Thus there exists a great region of 8,000,000 sq. mi. with relatively few railroads except in Argentina, Chile, restricted areas in Brazil, and in Mexico and Cuba. Improved highways are very limited in Latin America with the exception of one main highway each in Mexico, Cuba and Venezuela. Argentina and Chile likewise have some road development and Peru is building as rapidly as its resources will permit.

Argentina has developed and is developing a considerable manufacturing industry, as is Brazil in São Paulo, but with these exceptions the manufactures of Latin America are confined almost entirely to a few textile and sugar mills. There is no export commerce of importance from Latin America in any manufactured products with the exception of sugar and this, generally, is in the unrefined state. The exports from which they must derive their foreign exchange for the purchase of the manufactured products which they require are confined to products of the soil, the mine, the oil field and the forest. Their present exports of raw materials and the foreign exchange derived therefrom are insufficient to satisfy the full needs and desires of more than a relatively small percentage of the upper classes and with little for those of the lowest economic levels. Thus there is a vast territory to the south with abundant natural resources and an ample supply of good labor awaiting and needing development, and there is a great population awaiting and needing the articles which are considered to be the necessities of life in the United States.

With few exceptions the subsoil in all of the Latin American countries belongs to the people of the nation and not to the individual who by chance or otherwise happens to have selected a piece of land that overlies a rich natural resource. For this reason concessions for the development of mineral properties, forest resources, water powers and other resources must be obtained from and through the given Latin American government. This, in most cases can be done on a very fair and reasonable basis. In Brazil and Chile however, many of these resources, particularly petroleum, have been entirely nationalized and foreign individuals or corporations are prohibited from acquiring or developing them, though they do not prohibit their own native born nationals from such development. If this policy represents the national will there can be no just criticism of it, for there has been no expropriation or confiscation of any rights or concessions held by individuals or corporations. One may not agree with such a policy from a practical and economic standpoint, but it is unchallengable otherwise.

Trucks manufactured by Engineering Laboratories, Inc. for Seismograph Service Corp. and destined for use in South America.

When a new and virgin country is discovered and colonized the first step is normally and necessarily the development of its agricultural resources sufficient to supply the needs of the populace and usually with some excess for export. Next come transportation systems, the working of mineral resources, timber, and the like; then in normal order the construction of mills, plants and factories for the use of the raw materials produced in the country. To carry out these developments the young nation must have capital and it must have trained men. Such is the history of the United States. Without heavy investments of foreign capital it could not possibly have become developed to its present industrial and financial strength. Foreign executives and engineers directed many of its enterprises for generations. Its transportation systems, many of its great ranches and probably the majority of its heavy manufacturing industries were owned originally by foreigners and in many cases they were built and were operated by foreigners. As time went on the ownership of these vast corporations gradually drifted into American hands and finally with the coming of the world war the change was made almost complete, and with this war probably it will be made entirely so. Thus has the United States reached the pinnacle in wealth among the nations of the world, through the aid of foreign capital and foreign technicians, most of whom have later become American and have been in fact the source of the American nation. No new country can develop without such assistance of men and money.

The countries of the southern continent did not develop as did the United States because the culture and economic theories of these countries were from a different people and that source was not in highly industrialized, wealthy, colonizing nations. In consequence, with the exception of the few investments made by peoples from the north of Europe and North America, Latin America today is little changed from the Latin America of one hundred years ago and it is for all practical purposes, frontier country. These countries need above all things, else, capital, engineers and industrialists to develop their vast resources. Otherwise they can never attain the full measurements of national wealth and prosperity, the basis for which nature has provided in abundant natural resources. If this fact is fully appreciated their laws will offer inducements and protection to the

foreign developers of mines, transportation systems and industry generally. Eventually the works of this foreign capital and of these foreign engineers will revert to the ownership of the people of the country in which they are built. The engineers and manufacturers will become citizens and generations of new and fresh blood of a sorely needed type will be born. This is happening and has happened to a very considerable extent in Argentina and Chile and to a lesser extent in southern Brazil, but still, these and the other frontier nations are in need of financial and technical aid from the outside world.

Mexico has done irreparable harm to its southern neighbors by the confiscation of foreign owned oil and other properties, thus giving cause for foreign capital to hesitate before going into any of the Latin American countries, and it is a long and serious hesitation. The government of the United States has permitted the damage to be done by not requiring of Mexico adequate compensation to reimburse the foreign operators and capitalists for their confiscated properties. A strong, honest hand is usually admired. At the same time the foreign operator cannot expect to exploit the resources of a country entirely for his own selfish benefit. He may logically and fairly expect to earn a profit justified by the hazards involved, but his host nation must likewise be allowed its reasonable and fair proportion. Capitalists have not always adhered to such rules of fairness, which accounts in part for the ill-repute in which foreign capital and operators are sometimes held in Latin America.

North American engineers and technicians are of very high caliber and they are peculiarly suited to pioneer operations. The United States has an enormous surplus of capital that has been lying unused in the banks for years and will probably continue to lie there for years to come. To the southward there is undeveloped wealth in nature's storehouse, awaiting the drill that operates beneath the derrick or the drill that works on a small steel tripod. There are highways and railroads to be built, water powers to be harnessed, vast timber resources to be exploited, mines to be worked and without questions great, undiscovered mineral deposits to be prospected and developed. It, seems that each has what the other requires, that they are economically complementary the one having the capital and technical personnel and the other the undeveloped raw materials and the work to be done. The one thing needed is a proper understanding and recognition of what is a fair and reasonable basis for cooperation.

Important strides toward meeting the situation are being taken through the State Department of the United States, the Department of Commerce, the Export-Import Bank, and the Reconstruction Finance Corporation. All these are laying a splendid foundation for closer cooperation. The investing public, however, still has to overcome the fear caused first by many of the South American nations defaulting on bond issues and second by the confiscation of foreign owned properties by the Mexican and Bolivian governments. In the first of these the South American governments are not entirely to blame by any means. In many instances bond issues were placed without proper safeguards. They were spent for purposes which did not increase the revenue of the countries involved and therefore there were no additional earnings available to permit them to carry their interest charges to say nothing of setting up sinking funds for retirement of the bonds.

Similar conditions came into existence following the war between north and south in the United States when the so-called carpetbaggers from the North and their puppet governments of the Southern states floated vast bond issues and wasted the funds obtained therefrom. The later legitimate governments of these states were forced to default. They had no possible means with which to pay, for the monies had been dissipated in channels which could produce no revenue, directly or otherwise.

A great deal of money has been lent in Latin America for specific purposes with revenue earmarked for the payment of interest and the establishment of sinking funds on the issues. In many cases American engineers and executives have carried on the developments which upon completion are of themselves revenue earning either directly or indirectly. There has been little if any default on loans of such types.

With the turmoil of the world today, with the jealousies, the ambitions, the greed of nations, the Americas are fortunate in being separated from the older world by two broad oceans, but in order that the lands of the Western Hemisphere may be kept from falling under the domination of theories of government, destructive of their fundamental liberties they must strengthen their barriers, political, economic and defensive. Just as the natural market of a given state of the Union is all of the other states, so is the natural market of one nation of the Western Hemisphere all of the other nations. The two continents can be made entirely self-sustaining; what one lacks the other has in abundance. With full cooperation amongst these western nations their cultural, social and economic lives may be complete and they can make themselves politically secure.

There are three essentials to a complete understanding between the peoples of North and South America; first, we of the North must impress upon Latin America the fact that we are not imperialistic and have no desire for additional territory or territorial control and that their political systems are their affairs and not ours, and, also, that their social customs and ideals are fully respected and appreciated by us and are inviolate in our hands. Further, our commercial relations with them must be liberal from a credit standpoint and fully and unquestionably honest in negotiations and in the products and commodities supplied them. A second condition is that the Latin Americas in turn must abide by the rules of fair international commerce and respect the unwritten laws of trade and relationships between nations regardless of the treaties which may be extant, and they too must endeavor to understand or at least to be tolerant of our culture and customs. Third and finally, each must understand the language of the other, for only through this medium of the exchange of ideas can we come to understand the culture and customs of each other and finally realize that most desired and necessary international relationship.

With such a mutuality of confidence and respect that these would bring about, the United States may and can supply to Latin America the necessary capital, executives, engineers and technicians for the development of their vast mineral resources, their deposits of oil and the development of the resources of their rivers, soil and forests. Paralleling these developments there would of necessity be the construction of railroads and highways and the institution of additional air service and water transportation on navigable streams, coastwise and international. The contemplation of a system of highways through the central plateau of Brazil excites and thrills the imagination!

Latin America can supply the United States with the manganese, tin, quinine, rubber and many other commodities which today are drawn from other parts of the world, in addition to those items of commerce now being furnished. With greater revenue thus made available to its peoples Latin America will require more of those articles which tend to render life less burdensome and more congenial. Also there should develop under such circumstances a great volume of commerce between the Latin American nations themselves, which is practically nonexistent at this time.

All of this may be summed up in the statement that in order to sell one must buy, and conversely, in order to buy one must sell. Therefore, until the great wealth of natural resources of Latin America are developed to a much greater extent than presently obtains, it cannot purchase its reasonable requirements for a fuller and more comfortable existence. Latin America cannot develop this natural wealth without the very liberal assistance of foreign capital, foreign executives and foreign engineers. It seems to be an endless circle but such is not the case. There is a beginning, and that is for the Latin American governments and peoples, if they desire such development, to instil in the investing public of the United States of America that confidence which is required before its hard earned dollars will be risked in Latin American fields. On the other hand North Americans must likewise instil in the peoples of Latin America the knowledge that they are interested only in developing normal, logical and legitimate commercial intercourse in which their investments are secure from a political standpoint and from which a reasonable return on the invested capital may be realized.

The original move will have to be made by the Latin Americans; the countries belong to them and they must first give the invitation. There is no doubt but that they will do this in

time for they are fully aware of the fact that in order to buy they must sell, and they realize that at the present time they have a wholly insufficient quantity of materials to offer on the markets of the world in return for their requirements. Therefore, they must produce more, which means an invitation to foreign capital to come into their countries and carry on development work. Their production for export is presently and for a long time to come will be limited to their natural resources, but the possibility or desirability of local manufacturing industries should always be borne in mind. American colleges and universities and public institutions generally should recognize the needs of the two peoples and endeavor to meet the requirements of the situation. This will have to go farther than the usual casual study of languages. It should include a serious, exhaustive study of each other's culture and history in order to bring about a sympathetic appreciation and understanding. The tendency of many North Americans to offer generally unjust and inaccurate criticisms, based on insufficient knowledge of the Latin American countries derived from too brief visits to them or to lack of understanding of or sympathy with their customs and culture, should by all means be avoided. Much effort is required to right a wrong and time is precious now. Latin Americans may also be cautioned in the same regard.

CONCLUSIONS

The European conflict has disrupted, if it has not entirely destroyed the normal flow of world commerce for at least generations to come. In consequence Latin America may no longer be able to enjoy its former rich European markets, for regardless of the manner of termination of the war the peoples of Europe will be entirely without the usual medium of exchange for the satisfaction of international contracts. It has been by means of this medium of exchange that Latin America has had the privilege of trading its raw products for those manufactured commodities which it requires in order that it may enjoy a tolerable existence. In a Germanized Europe they will no longer have this privilege of selection, for the totalitarian governments will force upon these less self-sustaining nations a barter system and through it those products which Europe chooses to exchange for the raw products and labor of Latin America.

It has been generally true in the past that the great majority of German products shipped to these countries has been of inferior quality and of dishonest manufacture. If a Hitlerized Europe is allowed to dictate the products of international commerce that must be accepted by South American countries in exchange for their crude products, then Latin America must adjust its mode of life and civilization to a different and less congenial plane. The position of the United States may become only slightly less distasteful, for its national prosperity likewise has depended to a great extent upon commerce with the nations of Europe and their dependencies.

Such possibilities or even probabilities as these indicate that the nations of the Western Hemisphere should look to each other for the satisfaction of their commercial and economic requirements. Though the change cannot be made over night and recognizing that peoples of both continents are presently but poorly prepared even to make an effective beginning the means do exist for organizing an interhemisphere exchange of commodities that should entirely satisfy the established mode of life and also the extension of the availability of those manufactured commodities which render existence more comfortable, to a more substantial percentage of both populations.

It has been stated that the Latin American countries now produce many of the raw materials which the United States and Canada require. Latin America could produce practically all of those commodities which are needed to support the American way of life and which the United States itself does not possess within its own boundaries in sufficient quantities. Many, if not the great majority of these resources of Latin America are yet to be developed, and those nations have neither the financial resources nor the executive or engineering experience with which to develop them. The United States has all of these things and a very important and necessary addition—the desire to undertake such development. Its people are essentially pioneers still, and the possibilities and opportunities for ventures of a pioneering nature that are offered in Latin America appeal very greatly to the character of North Americans generally. They have financial resources available to be put to work in any country which affords reasonable and proper security with a fair expectation of earnings commensurate with the hazards of the investments. There is no question but that Latin America can offer such opportunities for the safe and profitable employment of vast sums of money, which should be equally profitable to all of the peoples concerned. If the nations of Latin America desire the establishment of economic relationships that will permit the exchange of their natural resources and enormous potential supplies of labor for the commodities which they require, they must first extend the invitation to foreign capital and engineers by organizing reasonable laws and giving adequate assurances that they will be consistently enforced and interpreted on fair and reasonable bases.

The Latin American is an extremely proud individual, intensely patriotic, and he is very jealous of his prerogatives, rights and abilities. This has had a great influence in causing the Latin American governments of some of these countries to discourage foreign investments by one means or another, while others have failed to extend real encouragement. It would have been impossible for the citizens of North America to have developed their countries without the aid of foreign capital and personnel and it is equally true that the great frontier countries of Latin America cannot be developed otherwise. There are at least 80,000,000 people in these countries who exist on the bare necessities of life and who are entirely unfamiliar with those conveniences which render existence more satisfactory to the other 30,000,000. By elevating the plane of living of this enormous group or at least of that part which is susceptible of advancement, the national plane of life, the safety and the security of these nations will be greatly enhanced.

North Americans likewise have much to do to promote these greatly desired developments and relationships. They must provide the necessary capital and engineering skill on terms which are just and reasonable, and if they do accept the laws of a given country to that extent which will permit them to place investments in it, they must abide by both the letter and the spirit of those laws. They must entirely eliminate and avoid selfish exploitation and evidence a spirit of cooperative development and unselfish tolerance. Also they must allay their neighbors' fears of imperialistic designs which certainly are wholly imaginary.

North American manufacturers and exporters sometimes have the unfortunate attitude of attempting to sell to the Latin Americans those things which they themselves use and which they think others should use. Latin Americans have a culture and civilization of their own which does not always conform to the Anglo-American pattern. The commodities which they require or desire are frequently very different from those which other nationalities require or desire. Good salesmanship and profitable commerce necessitate a sympathetic understanding.

Both the Latin American and the Anglo-American nations, if they are to prosper and to retain their economic and political sovereignty, must inaugurate inter-hemisphere commerce to replace that being lost in other parts of the world. This will require untiring effort to develop a higher form of existence for all of their peoples and particularly for the 80,000,000 who occupy a lower economic status in Latin America and for a similar 20,000,000 in Anglo-America. In this manner the nations of the Western Hemisphere can make themselves culturally, economically and politically self-sufficient and secure.

Each nation of the Western Hemisphere produces commodities required by some other nation therein but established channels of commerce and a medium of exchange are not now available. The necessary channels must be organized and the United States must supply the medium of exchange to permit the free flow of products between these nations. This will require sacrifices by all concerned, particularly the United States, but these sacrifices will be infinitesimal compared to the distress that would be occasioned by the encroachment of totalitarian control of the economic and political destinies of the Western world. The United States cannot consider the cost for it will be purchasing security probably to a far greater extent than were the required sum added to those enormous appropriations which have been made for the defense of the nation. An immediate conference of international engineers and commercial experts with power to act within prescribed but adequate limits is imperative. And they should be instructed to act.

ACTIVE DEVELOPMENT in South America Likely on Conclusion of European Conflict

By E. Ospina-Racines
Petroleum Economist
Bogota, Colombia

An Analysis of the Five Major Factors Which Govern the Commercial Exploitation of Oil Regions of South America with a Consideration of Variations that May Encourage Development in Some Countries and Limit it in Others

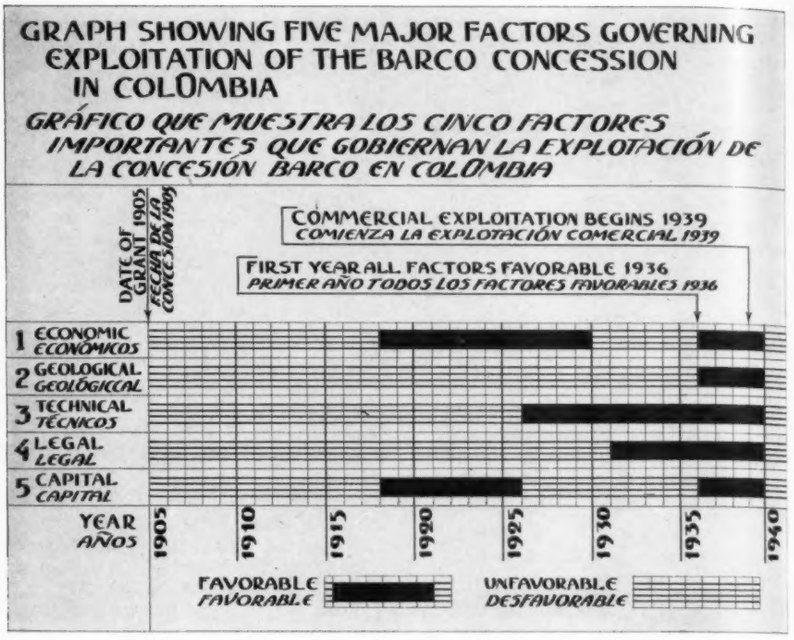


CHART I

THE armistice of 1918 marked the beginning of an intense development of the oil resources of South America. A glance at the figures exhibited in Table I, reveals that in 1918 the oil production of Latin America, including Mexico, reached 70,183,000 bbl., and within a score of years it had increased fivefold to 323,703,000 bbl. No other oil producing region of the world can show a more notable increase within twenty years.

Since the armistice of 1918 initiated an intensive development of the oil resources of South America, it is logical to assume that upon cessation of the present European conflict, the trend shown in Table I will be greatly intensified. Studying the particular figures of the countries listed it is of interest to note that while South America as a whole experienced a fivefold increase in oil production, nevertheless not all countries participated equally in this trend. Mexico, for example, experienced a decline of 33⅓ percent, taking the 1918 and 1930 figures alone, and showed no improvement at all for the past nine years. This however, was due to a decline in existing flush fields and to internal conditions that discouraged development.

The question which naturally arises is whether there is something significant regarding the fivefold increase in oil production of South America and why some countries forged ahead as oil producers, while others barely increased oil production and one showed a decided falling off.

The answer to this query is that the business of oil production is a highly speculative venture wherein five major factors intervene, each of which is a combination of elements and unless all of these present a favorable outlook commercial exploitation may not take place. These five major factors which have shaped the course of development of the oil resources of South America are indicated by the following questions:

1. Is there an adequate demand for oil and is the price at seaboard attractive?

2. Is there sufficient geological evidence to warrant surface and subsurface exploration and does such evidence indicate a large scale development?

3. Do the technical advances in the art of exploring, producing and transporting oil permit economical exploitation of the prospective land?

4. Do the laws governing the exploitation of oil on private and national lands, as well as the social and tax laws, carry equitable and enlightened provisions?

5. In view of the above considerations is there sufficient interest on the part of capital to enlist as entrepeneur and assume the attendant risks in the development of the prospective oil property?

Each of the countries listed could be the object of a detailed study with respect to the five major factors mentioned, the result of which would reveal why some countries forged rapidly ahead as oil producers while others, like Colombia, show but a slight increase in oil production in a decade. Such investigation would be lengthy and since oil production is obtained from concessions granted by governments of the various countries, the logical procedure is to analyze the development of an oil concession, interpret this for the country as a whole and arrive at a conclusion with respect to South America and the immediate future.

As a typical illustration of how the five factors influence the development of an oil concession in a South American country, the case of the Barco concession of Colombia which recently entered into a period of commercial exploitation is selected. The accompanying Chart I depicts the course of the five factors from the time the Barco concession was originally granted in 1905 to the present. The years marked in black indicate the period which each particular factor was favorable to commercial exploitation. As may be seen it was not until 1936 that all five factors appear black, an indication that commercial exploitation would soon follow. Chart II shows the present status of the five factors for the principal oil countries of Latin America. A rating of five means that they are all propitious to further oil development in the particular country whereas any country rating less than five cannot expect any great increase in exploration and oil production. An appreciation of the significance of these five factors is brought out in the following discussion with reference to the Barco concession.

The economic factor involves an adequate demand for oil and an attractive price at tidewater. The prevailing demand for crude oil during the period 1905 to 1917 when General Barco sought the development of his concession, may be gauged from the value of crude

Es Probable Un Activo Desarrollo En Sur America A La Terminacion Del Conflicto Europeo

Por E. Ospina-Racines
Experto en Petróleos.
Bogotá, Colombia.

Análisis de los Cinco Factores Principales que Rigen la Explotación Comercial de las Regiones Petroleras de Sur América, con Consideraciones sobre las Variaciones que pueden Estimular el Desarrollo en Algunos Paises y Limitarlo en Otros.

EL ARMISTICIO de 1918 marcó el comienzo de un intenso desarrollo de los recursos petrolíferos de Sur América. Una mirada a las cifras que se muestran en la Tabla I, revela que la producción de petróleo en la América Latina, inclusive México, era en 1918 de 70.183.000 barriles y en una veintena de años se había quintuplicado llegando a 323.703.000 barriles. Ninguna otra región productora de petróleo en el mundo puede señalar un aumento tan notable en el curso de veinte años.

Puesto que el armisticio de 1918, inició un intenso desarrollo de los recursos petrolíferos de Sur América, es lógico suponer que con la terminación del actual conflicto europeo, se intensificará considerablemente la tendencia indicada en la Tabla I. Estudiando las cifras que corresponden a cada uno de los paises en la lista, es interesante observar que a pesar de que Sur América en conjunto señaló un aumento quintuple en la producción de petróleo, sin embargo, no todos los paises participaron igualmente en esa tendencia. México, por ejemplo, sufrió una baja de 33-1/3%, tomando las cifras de 1918 y 1930 solamente, y no mostró ninguna mejora en los últimos nueve años. Esto sin embargo se debió a una disminución en los campos productivos en existencia y a condiciones internas que desanimaron el desarrollo.

PRESENT STATUS OF CENTRAL AND SOUTH AMERICAN OIL COUNTRIES WITH RESPECT TO POSSIBLE FUTURE OIL DEVELOPEMENT

ESTADO ACTUAL DE LOS PAISES PETROLEROS CENTRO Y SUR AMERICANOS CON RESPECTO AL POSSIBLE DESAROLLO FUTURO DE LOS PETRÓLEOS

STATUS OF FACTORS ~ *ESTADO DE LOS FACTORES*

COUNTRY *PAIS*	ECONOMIC *ECONÓMICOS*	GEOLOGICAL *GEOLÓGICOS*	TECHNICAL *TÉCNICOS*	LEGAL *LEGAL*	CAPITAL *CAPITAL*	RATING *CLASIFICACIÓN*
1 MEXICO *MÉXICO*	O	X	X	O	O	2
2 PERU *PERU*	X	X	X	X	X	5
3 TRINIDAD *TRINIDAD*	X	X	X	X	X	5
4 ARGENTINA *ARGENTINA*	X	X	X	O	O	3
5 VENEZUELA *VENEZUELA*	X	X	X	X	X	5
6 COLOMBIA *COLOMBIA*	X	X	X	X	X	5
7 EQUADOR *EQUADOR*	X	X	X	X	X	5
8 BOLIVIA *BOLIVIIA*	O	X	X	O	O	2
9 BRAZIL *BRASIL*	X	O	X	O	O	2
10 CHILE *CHILE*	O	O	X	O	O	1

STATUS *ESTADO*
- X FAVORABLE *FAVORABLE*
- O UNFAVORABLE *DESFAVORABLE*

RATING *CLASIFICACIÓN*
- 5 PROBABLE INTENSE DEVELOPEMENT *PROBABLE DESARROLLO INTENSO*
- -5 PROBABLE INSIGNIFICANT DEVELOPEMENT *PROBABLE DESARROLLO INSIGNIFICANTE*

CHART II

La pregunta que surge naturalmente es si hay algo significativo en esta quintuplicación de la producción petrolífera de Sur América y porqué algunos paises continuaron progresando como productores de petróleos mientras que otros escasamente aumentaron sus respectivas producciones y uno mostró una marcada disminución.

La respuesta a esta pregunta es que el negocio de producción de petróleos es una empresa altamente especulativa, en la cual intervienen cinco factores principales cada uno de los cuales es una combinación de elementos, y a no ser que todos ellos presenten una perspectiva favorable, la explotación comercial puede no llevarse a cabo. Estos cinco factores principales que han dado forma al curso del desarrollo de las riquezas petrolíferas de Sur América, se distinguen por las siguientes preguntas:-

1. Hay una demanda adecuada por petróleo, y es atractivo el precio en la costa?
2. Existe suficiente evidencia geológica para justificar exploriciones superficiales y del subsuelo e indica tal evidencia un desarrollo en grande escala?
3. Permiten los adelantos técnicos en el arte de exploración, producción y trasporte del petróleo la explotación económica de la tierra en perspectiva?

A tremendous amount of geological and geophysical work has been carried on throughout South America, but far more remains to be done; above, a recording truck of Seismograph Service Corp. in Argentina.

oil exports from the United States, at that time the principal world supplier of oil. In 1905 the exports of crude oil were valued at $6,086,000 and in 1917 they had reached only $7,310,000. In contrast to these figures, the estimated value of crude oil exports from the terminal of the Barco concession for the current year may reach $9,000,000, a sum greater than the total annual value of United States exports during the period 1905-1907. The international market demand for crude after 1918 may be gauged by the Mexican exports which rose from 57,767,000 bbl. for that year to a high of 180,000,000 bbl. in 1922. Venezeulan oil production and exports supplanted the decline of Mexican exports. Not until 1921 did exports reach 1,000,000 bbl. but in 1930 exports had reached 138,499,000 bbl. These figures disclose the fact that since the Barco concession is potentially able to export 9,000,000 bbl. of oil annually under present circumstances, only after 1918 was there an adequate demand for crude oil in the international market and before this date this particular element of the economic factor was unfavorable.

Wherever oil may be produced in Colombia it will necessarily compete with oil available in the Caribbean and on the Texas-Gulf coast where the world price for crude oil is regulated. A study of the prices posted at the Texas Gulf coast since 1905 reveals one of the reasons why the Barco concession remained dormant for such long period.

In the midst of the Colombian jungle, Richmond Petroleum (California) furnishes comfortable quarters and a well equipped laboratory in this Magdalena house boat.

In 1905 the price of crude on the Gulf coast was $0.24 per barrel and in 1916 it had reached only $0.75. In 1918 it climbed to $1.70 at which time the Barco concession was the object of a transfer to American oil interests. Apparently an attractive price prevailed at seaboard. Crude prices rose, reaching $2.11 in 1920, falling thereafter continuously to a low of $0.66 in 1933. In 1936 a price of $1.13 per barrel was an attractive level of prices in view of the Texas-Socony purchase of the Gulf holdings in the concession. The economic factor is shown on the chart from 1918 to 1930 and since in view of the international demand and price for crude oil in the world market.

The geological factor was very uncertain until 1936 inasmuch as the commercial possibilities of the prospective oil land had been gauged only by oil and gas seepages discovered by General Barco and the structural aspect of the region. The first wildcat spudded in February 1933, later reaching 490 ft. and taking fire. The first productive wildcat was completed August 1934, reaching 3,008 ft. and showing a potential of 1,200 bbl. per day. By 1936 the drill had revealed evidence of commercial potentialities as indicated by the statistics herewith. Table II shows that in 1936 a total of 17 wells had been drilled of which one was in the Rio de Oro field and the rest on the Petrolea structure. The potential production per day of the nine wells in 1936 was estimated at 10,278 bbl. and in 1937, with three additional productive wells it had reached 12,680 bbl. or just about one half of the minimum 3,000 tons per day production which was stipulated in the contract for proceeding with the construction of a pipeline to the Colombian coast. In 1938, the 41

4. Tienen las leyes que gobiernan la explotación de petróleo en tierras nacionales y particulares, así como también las disposiciones sociales y tributarias medidas equitativas y claras?

5. En vista de las consideraciones anteriores, hay suficiente interés por parte del capital para entrar como empresario y asumir los riesgos consiguientes en el desarrollo de la propiedad en perspectiva?.

Cada uno de los paises mencionados en la lista podría ser objeto de un detallado estudio con respecto a los cinco puntos principales mencionados, cuyo resultado revelaría porqué algunos paises han avanzado rápidamente como productores de petróleo, al paso que otros como Colombia muestran solamente un pequeño aumento de producción petrolífera en un decenio. Una investigación de esta naturaleza sería lenta y puesto que la producción de petróleo se obtiene mediante concesiones otorgadas por los gobiernos de los varios paises, el procedimiento lógico es analizar el desarrollo de una concesión de petróleos, interpretarla para el país en conjunto, y llegar a una conclusión sobre Sur América y el porvenir inmediato.

Como illustración típica de la manera en que los cinco factores influyen sobre el desarrollo de una concesión de petróleos, en un país sur americano, elegiremos el caso de la Concesión Barco, de Colombia, la que recientemente ha entrado en un período de explotación comercial. El Cuadro I que se acompaña describe el curso de los cinco factores desde cuando la Concesión Barco fue otorgada originalmente en 1905, hasta el presente. Los años marcados en negro indican el período en que cada factor individual era favorable a la explotación comercial. Como puede observarse, los cinco factores no se ven en negro sino hasta 1936, indicación de que la explotación comercial pronto llegaría. El Cuadro II muestra el estado actual de los cinco factores para los principales paises petroleros de la América Latina. Una clasificación de cinco significa que todos ellos están propicios para fomentar el desarrollero petrolífero en el país en referencia. y cualquier país que muestre una clasificación de menos de cinco, no puede esperar un gran aumento de producción y exploración petrolíferas. La importancia de estos cinco factores se pone de relieve en la siguiente discusión referente a la Concesión Barco.

El factor económico envuelve una adecuada demanda por petróleo y un precio atractivo en puerto de embarque. La demanda por petróleo crudo que existía en el período de 1905 a 1917, cuando el General Barco buscaba el desarrollo de su concesión, puede medirse por el valor de las exportaciones de petróleo crudo de los Estados Unidos, quienes eran en esos momentos los principales proveedores de petróleo en el mundo. En 1905, las exportaciones de petróleo crudo valieron $6.086.000, y en 1917 llegaron solamente a $7.310.000. En contraste con estas cifras se calcula que el valor de las exportaciones de petróleo crudo desde el Terminal de la Concesión Barco, en el año en curso, puede llegar a $9.000.000, o sea, una suma mayor que el valor total anual de los exportaciones de los Estados Unidos durante el período de 1905-1907. La demanda del mercado internacional por crudo a partir de 1918, puede calcularse por las exportaciones mexicanas que subieron de 57,767,000 barriles en ese año a 180,000,000 de barriles en 1922. La producción y las exportaciones de petróleo venezolano reemplazaron el decline de las exportaciones mexicanas. No fue sino hasta 1921 que las exportaciones llegaron a 1,000,000 de barriles, pero en 1930 habían llegado las exportaciones a 138,499,000 barriles. Estas cifras revelan el hecho de que puesto que la Concesión Barco es potencialmente capaz de exportar 9,000,000 de barriles de petróleo anualmente en las circunstancias actuales, unicamente después de 1918 hubo una demanda adecuada de petróleo crudo en el mercado internacional y antes de esta fecha este elemento individual del factor económico era desfavorable.

Dondequiera que se produzca petróleo en Colombia, competirá necesariamente con petróleo disponible en el Caribe en la costa Texas-Golfo, en donde se regula el precio mundial del petróleo crudo. El estudio de los precios que se han fijado en la costa Texas Golfo desde 1905, revela una de las razones porqué la Concesión Barco se mantuvo latente por un tiempo tan largo.

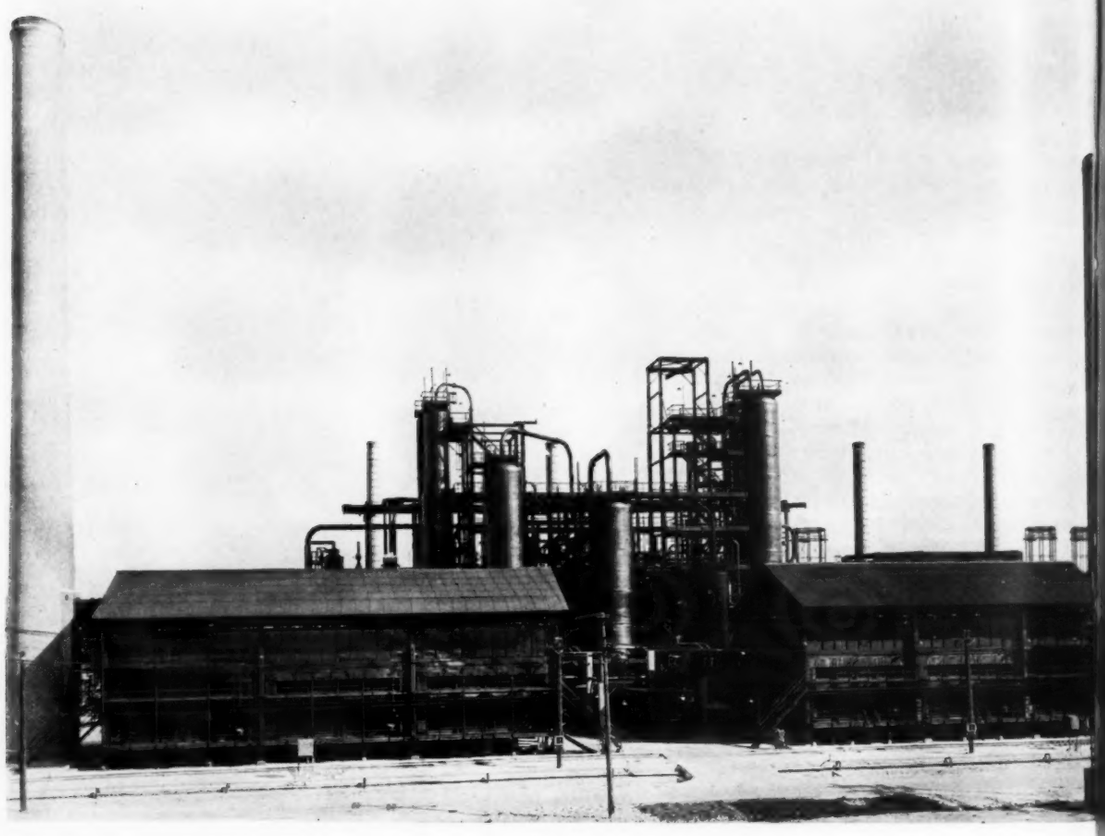
En 1905, el precio del crudo en la costa del Golfo era de $0.24 por barril, y en 1918 había llegado solamente a $0.75. En 1918 subió a $1.70, y en ese tiempo la Concesión Barco fue traspasada a intereses petroleros americanos. Aparentemente prevalecía un precio atractivo en la costa. Los precios del crudo subieron, llegaron a $2.11 en 1920, y cayeron después continuamente hasta llegar a $0.66 en 1933. En 1936, un precio de $1.13 por barril era un nivel de precios atractivo en vista de la compra por la Texas-Socony de los intereses de la Gulf en la concesión. El factor económico se muestra en el cuadro desde 1918 hasta 1930 y de ahí en adelante en vista de la demanda internacional y del precio del petróleo crudo en los mercados mundiales.

El factor geológico fue muy incierto hasta 1936, puesto que las posibilidades comerciales de las tierras de petróleos en perspectiva habían sido medidas unicamente por filtraciones de petróleo y de gas descubiertas por

Mexicana Aerofoto, S. A.

Airview of the Poza Rica field at an early stage of its development before expropriation: Because the equipment was new and the field flows under natural pressure a large proportion of Mexican exports come from this field.

THE POLYFORM AND



Large polyform or gas reversion full crude cracking plant. Now under construction by Lummus are two naphtha polyform plants to produce, respectively, 10,000 and 4,000 barrels per operating day of very high octane gasoline from heavy naphtha and outside propanes and butanes.

LUMMUS

Gas Reversion PROCESSES

produce:

— **gasoline with good distillation characteristics, good color, gum and oxidation stability; same high octane throughout entire boiling range.**

— **research octane of from 85 to 95.**

— **a spread between the CFR-ASTM and research octane of from 9 to 14 numbers—and between CFR-ASTM and road octane of 3 to 8 numbers, depending on feed stock and operation.**

— **high blending value and good lead susceptibility.**

— **high overall yields.**

— **aviation gasoline base stock.**

— **toluene, benzol, xylene.**

The polyform and gas reversion processes offered by Lummus, operating under patents of the Phillips Petroleum Company and Gulf Oil Corporation, have had over four years refinery production on large scale units. Ten polyform and gas reversion plants are in operation. The processes make possible the production of high octane gasoline with low specific gravity fuel gas from *all* cracking stocks. When applied to gas oils or reduced crudes, conversions per pass approximately double those obtained by conventional cracking are possible. Full crudes may be selectively cracked. Non-residuum full coking operations may be obtained if desired.

PETROLEUM REFINING PLANTS

THE LUMMUS COMPANY, 420 Lexington Avenue, NEW YORK, N. Y.

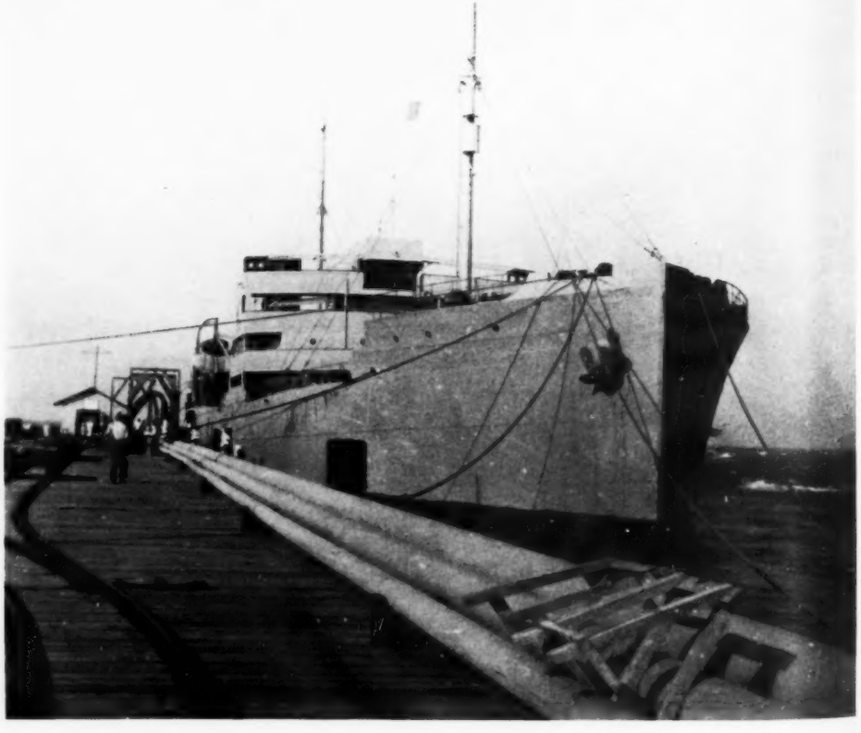
00 SOUTH MICHIGAN AVENUE, CHICAGO, ILL. • 411 WEST FIFTH STREET, LOS ANGELES, CAL. • 3020 WROXTON AVENUE, HOUSTON, TEXAS

BUSH HOUSE, ALDWYCH, LONDON, W.C.2 • FLORIDA 671, BUENOS AIRES, ARGENTINA

Left, a view of El Centro, Tropical Oil Company's camp in the Magdalena Valley of Colombia, for many years sole source of Colombia's important exports of petroleum; now, oil from the Barco Concession is reaching world markets via such tank ships as the Nueva Granada shown below loading at the Covenas terminal of the SAGOC pipeline.

productive wells on the Petrolea structure indicated a potential of 61,991 bbl. per day and five on the Rio de Oro 8,792 bbl. per day. From the statistical data it may be concluded that the test drilling results up to 1936 were encouraging and in 1938 sufficient potential production had proven the field for commercial exploitation. The geological factor as revealed by the drill, is shown favorable since 1936 in view of these data.

The technical factor refers to advances in the art of exploring, drilling, and pipeline construction which would make it possible to carry out operations of this nature at an economical figure. As may be appreciated it is not possible to fix values to assess these factors. With respect to exploration, the contract provides the selection of 200,000 hectares (500,000 acres): 50,000 hectares during the first five years and the balance in the next five years. The total area to be explored is about 400,000 hectares, a region of dense tropical forest and of difficult access where aerial exploration must necessarily be employed. Drilling is shallow, ranging from 440 ft. to 3,045 ft. in the Petrolea structure and from 1,060 to 6,717 ft. in the Rio de Oro field. The average depth from which production is obtained in the Petrolea field is 1,300 ft. The pipeline connecting the Barco concession with the Caribbean port of Covenas rises from 200 ft. above sea level to 5,300 ft., where it crosses the eastern cordillera at Rieber Pass. The pipe is 12 in. in diameter, in high tensible strength and was electrically welded throughout its length of 261 miles. The line has at present three centrifugal pump stations with high speed



750 h.p. Diesels and while it operates normally now at 750 lbs. per sq. in., during the initial period it worked under 1,080 lbs. per sq. in. pressure. The aeroplane played a major role in investigating the pipeline route, mapping, and in transporting food, material and machinery to the various construction camps. Ten freight planes were employed

el General Barco, y por el aspecto estructural de la región. El primer pozo de prueba (wildcat) principió en Febrero de 1933, alcanzando más tarde 490 pies e incendiándose. El primer pozo de prueba (wildcat) productivo fue terminado en Agosto de 1934, llegando a 3008 pies y mostrando una potencialidad de 1200 barriles diarios. Hacia 1936 la perforación había revelado la evidencia de posibilidades comerciales según se indica en las estadísticas que se acompañan. La Tabla II muestra que en 1936, se había perforado un total de 17 pozos, de los cuales uno estaba en el campo de Rio de Oro y el resto en la estructura de Petrólea. La producción potencial diaria de los nueve pozos en 1936 se calculó en 10,278 barriles y en 1937, con tres pozos adicionales en producción, había llegado a 12,680 barriles, o sea justamente casi la mitad del mínimo de 3000 toneladas por día, que era la producción que se había estipulado en el contrato para proceder a la construcción del oleoducto a la Costa Colombiana. En 1938, los 41 pozos productivos en la estructura de Petrólea, indicaron una potencialidad de 61,991 barriles por día y cinco de los del campo de Rio de Oro 8,792 barriles diarios. De los datos estadísticos puede deducirse que los resultados de los ensayos de perforación hasta 1936 eran animadores y que en 1938 la producción potencial había probado el campo para explotación comercial. El factor geológico, como lo revelan las perforaciones, se muestra favorable desde 1936 en vista de estos datos.

El factor técnico se refiere a adelantos en el arte de explorar, perforar y construir oleoductos que permitan llevar a cabo operaciones de esta naturaleza a un costo económico. Según puede apreciarse no es posible fijar valores para determinar estos factores. Con respecto a exploración el contrato establece la selección de 200,000 hectáreas (500.000) acres: 50.000 hectáreas durante los primeros cinco años y el resto en los próximos cinco años. El área total a explorarse es de alrededor de 400.000 hectáreas, en una región de densos bosques tropicales y de difícil acceso, en donde necesariamente hay que acudir a exploración aérea. La perforación es poco profunda variando de 440 pies a 3045 pies en la estructura de Petrólea y de 1060 a 6717 pies en el campo de Rio de Oro. El promedio de profundidad a que se logra producción es de 1300 pies en el campo de Petrólea. El oleoducto que conecta la Concesión Barco con el puerto de Coveñas en el Caribe, sube de 200 pies sobre el nivel del mar a 5300 pies en el punto en donde cruza la Cordillera Oriental en el Paso Rieber. La tubería es de 12 pulgadas de diámetro de alta fuerza de tensión y fue soldada electricamente en todo su trayecto de 261 millas. La linea tiene en el momento tres estaciones de bombas centrífugas con alta velocidad de 750 h. p. Diesels, y aunque ahora trabaja normalmente a 750 libras por pulgada cuadrada, trabajo durante el período inicial a 1080 libras por pulgada cuadrada de presión. El aeroplano

A United Geophysical truck stuck on a primitive road in Trinidad; transportation presents a major problem.

jugó un papel principal en la investigación de la ruta para el oleoducto, en el levantamiento de mapas y en el trasporte de provisiones, materiales y maquinaria a los distintos campos de construcción. Se usaron 10 aviones de carga, se trasportó un total de 11,000,000 de libras de materiales, y se voló en total una distancia de 1,000,000 de kilómetros. En vista de estas consideraciones, el factor técnico se muestra favorable desde 1926.

El factor legal se muestra favorable desde 1931, época en la cual el Congreso de Colombia aprobó el contrato bajo el cual se está llevando a cabo la explotación. La ley que gobierna el otorgamiento de concesiones petroleras así como también la ley sobre impuestos de renta formuladas a semejanza de la práctica americana de impuestos federales sobre la renta, datan de este año. La ley de petróleos fue complementada en 1935 en un esfuerzo para definir y permitir la explotación de petróleos particulares. El contrato original de 1905 otorgó al General Virgilio Barco el derecho de explotar los depósitos petrolíferos por cincuenta años, comenzando a partir de tres años de la concesión y pagando al Gobierno 15% de las ganancias netas. En 1918 el Gobierno aprobó un traspaso de la concesión a intereses petroleros americanos y pidió una modificación del contrato estipulando expresamente que la fecha de expiración era Octubre 1955, y sustituyó una regalía del 5% sobre la producción bruta en vez del porcentage sobre las ganancias netas. No se hizo mención de la construcción de un oleoducto a la costa. En 1926, fue cancelada la concesión y en 1918, esa decisión fue confirmada por el Gobierno. En 1931, después de lentas negociaciones, llenas de maniobras políticas y diplomaticas, se redactó un nuevo contrato que fue aceptado por el Gobierno y aprobado por el Congreso. Entre

and a total of 11,000,000 lbs. of materials were transported, flying a total distance of over 1,000,000 kilometers. In view of these considerations the technical factor is shown favorable since 1926.

The legal factor is shown favorable since 1931 at which time the Congress of Colombia approved the contract under which exploitation is being carried out. The law governing the granting of oil concessions, likewise the income tax law, modeled after American federal income tax practice, date from this year. In 1935 the oil law was complemented in an effort to define and permit the exploitation of private oil. The original contract of 1905 granted General Virgilio Barco the right to exploit the oil deposits for fifty years, starting within three years of the grant: fifteen percent of the net profits were to be paid to the government. In 1918 the government approved a transfer of the concession to American oil interests and called for amendment of the contract, stipulating specifically the expiration date as of October 1955 and substituted a five percent royalty on the gross production instead of the percentage of the net profits. No mention was made of the construction of a pipeline to seaboard. In 1926 the concession was cancelled and in 1928 the decision was confirmed by the government. In 1931, after lengthy negotiations with much political and diplomatic manœuvering, a new contract was drafted, accepted by the government, and approved by Congress. Among the principal features, this instrument provides a fifty year period from date of approval, certain tax and import duty exemptions, the right to construct a pipeline to the coast but through Colombian territory, a royalty either six percent at the port in cash or in kind or ten percent in kind at the field with the right of transporting such royalty in kind at a fixed tariff of $3.50 per metric ton or approximately 46 cents per barrel for 40 deg. A. P. I. oil. It is apparent that in view of the original contract, the amendments, and the cancellation, the period previous to 1931 was legally unfavorable to large scale development.

TABLE I

Progress of Oil Production in South America
(Thousands of Barrels)

Country	Years 1918	1930	1939
Mexico	63,828	39,530	39,428
Peru	2,527	12,499	13,588
Trinidad	2,082	9,419	19,270
Argentina	1,353	9,002	18,613
Venezuela	333	136,669	205,956
Colombia	.....	20,346	23,436
Ecuador	60	1,553	2,312
Bolivia	.....	56	100
Totals	70,183	229,074	323,703

Captial enlistment or an entrepreneur with sufficient financial resources and adequate international market connections is the fifth important element in the commercial exploitation of oil. The latter consideration is of special significance for countries like Colombia, Venezuela, etc. which do not have a large domestic consumption to warrant large scale operations. Moreover, the United States market which formerly permitted Mexico and Venezuela to develop radidly has since

On the outskirts of Agua Caliente in Eastern Peru.

been restricted by imposition of an import duty of 21 cents per barrel. Imports which amounted to 62,129,419 bbl. two years previous to the import excise tax dropped constantly thereafter, reaching 26,051,723 bbl. in 1938. According to the recent reciprocal trade treaty between the United States and Venezuela in which other South American countries participate under the most favored nation clause, oil producers will obtain an allowance of 10.5 cents per barrel on approximately 2,500,000 bbl. imported into the United States during the present calendar year. This quantity represents 8.6 percent of the expected 1940 production under normal circumstances.

The United States market being restricted by the import duty the entrepreneur who undertakes commercial exploitation of oil properties in South America must be able to dispose of large quantities of oil in the international market, namely Europe, Africa, Canada and the consuming countries of South America, such as Brazil, Uruguay and Argentina. The European market must be supplied on a competitive basis with oil from the United States, the Near and Far East.

The capital factor is indicated on the chart as favorable from 1918 to 1926 during the period when Henry L. Doherty & Co., the Carib Syndicate and the Gulf Oil Corporation were the principals. The United States was then the chief market outlet for South American crude. The capital factor is again shown as favorable since 1936, at which time the Texas-Socony companies bought the holdings of the Gulf Oil Corporation and later those of the Carib Syndicate. The passing of the Barco concession to the directorship of this financially capable combination having worldwide refinery outlets indicated that in 1936 all five major factors governing the commercial exploitation of oil outside the United States were propitious to a large scale development and that soon thereafter Catatumbo oil would be on the international market. This was realized in the latter part of 1939.

The foregoing method of analyzing the commercial possibilities of an oil concession in Colombia is applicable to the country as a whole and to the other oil countries of Central and South America. Fundamentally it shows that of the five factors the legal is in the hands of the governments, the capital in those of international oil producing and marketing companies. The technical advances of the industry can surmount any exploitation difficulty. From a geological point of view the Central and South American countries offer large areas of prospective oil land which must be proved by the drill.

The economic factor which involves an adequate demand and an attractive price at seaboard may be expected to be favorable upon cessation of present hostilities. Moreover the consumption of Argentina, Brazil and Uruguay offers a market which for the first two countries might be supplied entirely from indigenous sources if the legal factor were favorable which in turn would invite capital.

From the analysis it is apparent that the five fold progress of South America exhibited in Table I resulted from having either in one or more countries the five factors favorable to oil exploitation. The countries which did not participate in the fivefold increase during the years following the 1918 armistice failed principally because the legal factor was unfavorable during this period. Among these countries Mexico, Colombia, Argentina and Bolivia may be cited. The legal factor must be a forerunner to having the capital factor favorable and the former is in the decision of the respective governments.

TABLE II

Statistics Showing Progress of Proving Barco Concessions for Commercial Production

Year	Wells Completed		Productive Wells		Productive Wells Cumulative	
	Petrolea	Rio de Oro	Petrolea	Rio de Oro	Petrolea	Rio de Oro
1934	5	..	3	..	3	..
1935	5	..	3	..	6	..
1936	6	1	3	0	9	..
1937	4	3	3	2	12	0
1938	19	4	19	3	31	2
1939*	18	1	18	1	49	5
*July 1st						6

Year	Daily Potential Production in Bbls. Petrolea	Rio de Oro	Cumulative Daily Potential Petrolea	Cumulative Product'n Rio de Oro
1934	2,850	.....	2,850	.....
1935	3,240	.....	6,090	.....
1936	4,188	.....	10,278	.....
1937	2,402	3,948	12,680	3,948
1938	48,311	4,844	60,991	9,722
1939*	32,208	111	93,199	9,903
*July				

Chart II had been drawn up to indicate the present status of the five factors with respect to the nine oil countries of Central and South America. A rating of five means that the particular country may look forward to an intensive development of the oil resources of the country. Those countries which rate less than five can bring up the rating first by creating favorable legal conditions which, as mentioned before, is entirely in the hands of the respective governments. Once this takes place interest on the part of capital will follow which in turn will initiate test drilling to prove the prospective oil land. The technical factor is shown as favorable to all countries. The armistice which everyone hopes will take place soon will create a demand to make the economic factor favorable. Only those countries which rate five may expect to participate in supplying this demand. The 1918 to 1939 oil development period for the countries of South America bears out the fundamental reasoning which has been the object of this inquiry.

sus cláusulas principales este instrumento estipula un período de cincuenta años a partir de la fecha de aprobación, ciertas exenciones de impuestos y derechos de importación, el derecho de construir un oleoducto a la costa pero por territorio colombiano, una regalía del 6% en dinero o en producto en el puerto, o el 10% en producto en el campo con derecho a trasportar esa regalía en producto a una tarifa fija de $3,50 por tonelada métrica o aproximadamente 46 centavos por barril de petróleo de 40 grados A. P. I. Es aparente que en vista del contrato original, y las modificaciones, junto con la cancelación, el período anterior a 1931 fue legalmente desfavorable a un desarrollo en grande escala.

El quinto elemento importante en la explotación comercial de petróleo es la consecución de capital o de un empresario que tenga suficientes recursos financieros y conexiones en el mercado internacional. Esta última condición es de importancia especial para paises como Colombia, Venezuela y México que no tienen un gran consumo doméstico que justifique operaciones en grande escala. Además, el mercado estadounidense que anteriormente permitía que México y Venezuela se desarrollaran rapidamente, ha sido restringido desde entonces por la imposición de derechos de importación de 21 centavos por barril. Las importaciones que subieron a 62,129,419 barriles en los dos años anteriores a la imposición del derecho de importación, bajaron considerablemente desde entonces llegando a 26,051,723 barriles en 1938. De acuerdo con el reciente tratado de reciprocidad comercial entre los Estados Unidos y Venezuela, en el cual participan ciertos otros paises sur americanos que están dentro de la cláusula de la nación más favorecida, los productores de petróleo obtendrán una concesión de 10.5 centavos por barril, sobre aproximadamente 2.500.000 barriles importados a los Estados Unidos durante el presente año. Esta cantidad representa un 8.6% de la producción que se espera en 1940 en circunstancias normales.

TABLA I

Progreso de la producción de petróleo en Sur America. Miles de Barriles.

País	1918	1930	1930
1. Mexico	63,828	39,530	39,428
2. Perú	2,527	12,499	13,588
3. Trinidad	2,082	9,419	19,270
4. Argentina	1,353	9,002	18,613
5. Venezuela	333	136,669	205,956
6. Colombia	—	20,346	23,436
7. Ecuador	60	1,553	2,312
8. Bolivia	—	56	100
Totales	70,183	229,074	323,703

Estando el mercado de los Estados Unidos restringido por los derechos de importación, el capitalista que acometa la explotación comercial de las propiedadas petroleras en Sur América, tiene que estar capacitado para disponer de grandes cantidades de petróleo en el mercado internacional, a saber, Europa, Africa, Canada, y los paises consumidores de Sur América, tales como Brasil, Uruguay y la Argentina. El mercado europeo debe surtirse en competencia abierta con petróleo de los Estados Unidos, el Cercano y el Extremo Oriente.

Men in charge of United Geophysical trucks shown here counted themselves lucky to find modern means of transport en route to a remote location.

El factor capital se señala como favorable en el cuadro de 1918 a 1926, durante el período cuando Henry L. Doherty & Co., el Carib Syndicate y la Gulf Oil Corporation eran los principales. Los Estados Unidos eran entonces el centro principal para el crudo Sur Americano. El factor capital se ve de nuevo favorable desde 1936, en cuya época las compañías Texas Socony compraron los intereses de la Gulf Oil Corporation y más tarde los del Carib Syndicate. El traspaso de la Concesión Barco al directorado de esta poderosa combinación, que tiene facilidades de refinación en todo el mundo, indicó que en 1936 todos los cinco factores importantes que gobiernan la explotación comercial de petróleo fuera de los Estados Unidos eran propicios a un desarrollo en gran escala y que pronto a partir de entonces el petróleo del Catatumbo estaría en el mercado internacional. Esto se realizó a fines de 1939.

El método precedente de analizar las posibilidades comerciales de una concesión de petróleo en Colombia, es aplicable al pais en conjunto y a los otros paises petroleros de Centro y Sur América. Tal método muestra fundamentalmente que de los cinco factores, el legal está en manos de los gobiernos, el capital en las de las compañías internacionales de producción y distribución. Los adelantos técnicos de la industria pueden allanar cualquier dificultad de explotación. Desde un punto de vista geológico, los paises Centro y Sur Americanos ofrecen grandes áreas de posibles tierras petrolíferas que hay que probar por medio de perforaciones.

Es de esperarse que el factor económico que envuelve una demanda adecuada y un precio atractivo en la costa, será favorable con la cesación de las actuales hostilidades. Además, el consumo de la Argentina, Brasil y el Uruguay ofrece un mercado que para los dos primeros paises podría surtirse completamente con fuentes nativas si el factor legal fuera favorable, lo que a su vez invitaría el capital.

Es aparente de este análisis que la quintuplicación del progreso de Sur América que se muestra en la Tabla I, resultó de tener en uno o más paises los cinco factores principales favorables a la explotación petrolifera. Los paises que no participaron en este aumento quintuple, durante los años que siguieron al armisticio de 1918 fallaron principalmente porque el factor legal era desfavorable en ese período. Entre estos paises se puede citar a México, Colombia, Argentina y Bolivia. El factor legal debe ser el precursor para tener el factor capital favorable, y tal factor depende de la decisión de los respectivos gobiernos.

TABLA II

Estadísticas que muestran el progreso de probar la Concesion Barco para Produccion Comercial

Año	Pozos Terminados		Pozos Productivos		Pozos Productivos Acumulativos	
	Petróleo	Rio de Oro	Petróleo	Rio de Oro	Petróleo	Rio de Oro
1934	5	—	3	—	3	—
1935	5	—	3	—	6	—
1936	6	1	3	0	9	0
1937	4	3	3	2	12	2
1938	19	4	19	3	31	5
1939 (Julio lo)	18	1	18	1	49	6

Año	Producción Potencial Diariamente. En Barriles		Acumulativa Diariamente Producción Potencial	
	Petróleos	Rio de Oro	Petróleos	Rio de Oro
1934	2850	—	2850	—
1935	3240	—	6090	—
1936	4188	—	10278	—
1937	2402	3948	12680	3948
1938	48311	4844	60991	9792
1939 (Julio)	32208	111	93199	9903

El Cuadro II ha sido preparado para indicar el estado actual de los cinco factores con respecto a los nueve paises productores de petróleo en Sur y Centro América. La clasificación de cinco indica que ese país en particular puede confiar en un intenso desarrollo de los recursos petroleros del mismo. Los paises que tienen una clasificación menor de cinco, pueden llegar a esa clasificación creando condiciones legales favorables, las cuales como se ha dicho anteriormente, están completamente en manos de los gobiernos respectivos. Una vez que esto se lleve a cabo, vendrá el interés por parte del capital lo cual a su vez iniciará perforaciones de ensayo para probar las tierras petroleras en perspectiva. El factor técnico se muestra favorable a todos los paises. El armisticio que todos esperamos tendrá lugar pronto, creará una demanda para hacer el factor económico favorable. Unicamente los paises que tengan una clasificación de cinco, pueden esperar participación en el suministro de esa demanda. El período de 1918 a 1939 de desarrollo petrolífero para los paises de Sur América confirma el razonamiento fundamental que ha sido el objeto de este estudio.

Proposed South American Institute of Petroleum

Increasing Importance of South American Countries In Oil Production, Refining, and Utilization Suggests a Permanent Organization Which Has Been Proposed by Engineer Vegh Garzon, General Manager of A. N. C. A. P.

ENGINEER C. R. Vegh Garzon, who in addition to being General Manager of the A. N. C. A. P. of Montevideo, Uruguay, is also a member of the American Chemical Society and of the London Institute of Petroleum as well as the Asociacion de Ingenieros del Uruguay has proposed to the Executive Council of the Union Sudamericana de Asociaciones de Ingenieros a project for the formation of a South American Institute of Petroleum. Dr. Vegh Garzon's proposal will come up for consideration at the Lima convention which will assemble in January 1941 in that historic city. The proposal as presented to the Executive Council of the U. S. A. I. has already been the subject of consideration among the specialists and institutions of the oil producing and consuming countries of the South American continent. On June 20th, 1940 the Directive Council of the U. S. A. I. expressed general approval of the project for the formation of this institute of petroleum as outlined by Dr. Vegh Garzon.

In a communication to WORLD PETROLEUM, Dr. Vegh Garzon has outlined reasons which he considers fully justify the formation of this institute, touches on the functions which the institute should perform and describes the proceedure which he thinks should be followed in securing the cooperation of the South American countries for the formation of such an institute.

The importance that the South American continent has acquired in the production of oil is not new to anyone. According to statistics for the year 1939, South American crude oil production represented 13.60 percent of world production, practically equal to the entire production of Europe, including Russia, and surpassing the production of Asia (9.73 percent), including the Dutch East Indies, Iran, Iraq, Burma, etc. Venezuela is the third largest oil producing country in the world, crude output of that country being just below that of Russia, with the probability that Venezuelan production could surpass that of Russia. Argentina, Colombia, Peru and Trinidad also occupy places of importance among the oil producing countries of the world. Ecuador and Bolivia while producing moderate quantities of petroleum at this time have great potentialities. Vegh Garzon refers, not only to the present importance of South America among the oil producing areas of the world, but also to its great future possibility.

As a result of the outstanding and pioneer situation in the oil industry occupied by North America, the oil producing countries of South America have turned to the United States for guidance in technical and commercial aspects of petroleum exploration and exploitation.

This tendency has been heightened by the fact that much of the technical skill and experience as well as a large part of the capital necessary for exploitation of the South American oilfields has in the past come from the United States of North America.

However, as the exploratory phase of oil production in South America has resulted in the discovery of substantial productive fields, the operating companies and the governments of the oil producing countries have interested themselves in familiarizing the nationals of these countries in the operations connected with exploration, production, transportation and refining of oil. Governments of these various countries have turned their attention to the mineral wealth within their borders and have concerned themselves with related industries. In some cases, notably Argentina and Brazil, governments have launched programs leading toward the nationalization of the petroleum industry, or toward its exclusive operation by the nationals of the country concerned. The international companies operating in these areas have by the employment of local engineers helped to create a body of technical men whose origins and interests are primarily in South America.

Even in those countries where no tendency to nationalize the petroleum industry, is at present apparent, the government petroleum departments must be manned by a technically skilled group of engineers from within the country itself.

It may be seen, therefore, that within the past ten or fifteen years, the situation in South America has changed in respect to the interest of South American engineers in technical, commercial and industrial aspects of the petroleum industry. There now exists a large body of such engineers who could profit considerably by an interchange of ideas and experiences in the technique of producing, refining and transporting petroleum and petroleum products. Already there has been a certain amount of collaboration among the various South American countries in this respect. Argentina, for example, has effectively contributed to the development of the national petroleum policy in Uruguay and more recently, both Argentina and Uruguay have placed all their experience at the disposal of the Brazilian experts in order to assist them in the arduous task of developing the national petroleum industry with the resources that are available within Brazil itself.

In the opinion of Dr. Vegh Garzon, it has become necessary to give a definite and firm shape to this collaboration by creating a permanent institute which would place at the disposal of South American engineers and technicians the experience gained by other petroleum engineers and technicians throughout South America. This is in fact, given as the fundamental reason for the creation of a "South American Institute of Petroleum."

Dr. Vegh Garzon in the past has had occasion to be in close communication with technical and industrial aspects of a number of South American countries, such as Argentina, Peru, Bolivia and Brazil, and his contacts with professional and technical experts give him reason to affirm that in all these countries he has found promise of the fullest support for the idea responsible for his conception of the South American Institute. From a number of sources, Dr. Garzon has heard the opinion expressed that this institute would fill a void which is now noticeable in South America.

The institute would pursue a number of broad general purposes. First, it would seek to affiliate the experts of the South American institutions already in existence, which devote themselves or might wish to devote themselves to the exploitation of the petroleum industry in any of its phases. Secondly, it would place at the disposal of any country of the South American continent whatever knowledge has been gained in those countries which are now leading in the exploitation of their petroleum deposits as to technical and political control of their hydrocarbon resources.

In order to accomplish these purposes it would be necessary to establish a permanent seat of the institute in some city of South America and from this permanent headquarters, branches could be established in all the South American countries. A South American oil review, fully informative in its three aspects of industrial, commercial and technical divisions would have to be established together with an office for consultation and inter-change of information on matters relative to the South American petroleum industry. The review and the consultation office would be open to all experts and institu-

tions of South America who might wish to know the accomplishments realized in other countries. It would be necessary also to hold annual meetings of the members of the institute in various convenient cities of South America. At these meetings the findings of the various technical, commercial, and industrial experts would be considered and an opportunity would be afforded for the intensification of the personal ties between the technical experts which is, after all, the firmest basis for strengthening the affiliation of the institutions and the governments.

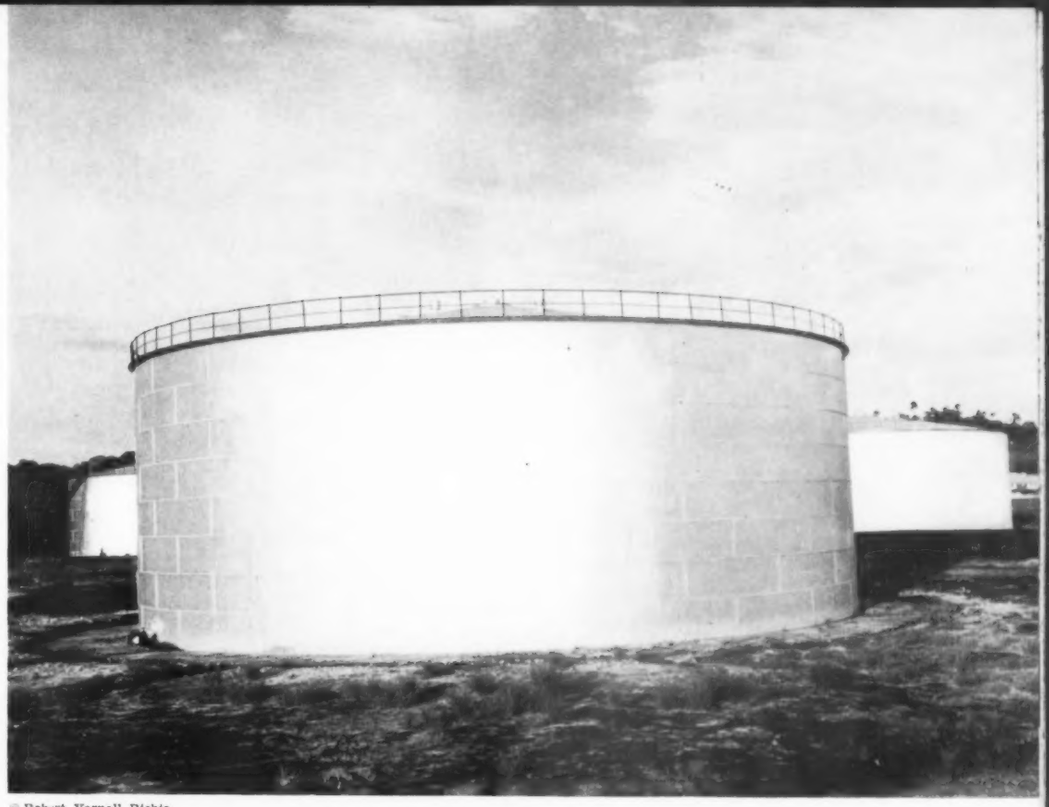
Although Dr. Vegh Garzon is aware that the work to be accomplished in the formation and carrying on of this institute would present some difficulties and would be of a costly nature requiring ample funds, he expresses the belief that these obstacles may be discounted since the governments of the South American countries and the petroleum institutions that already exist in some of these countries, could supply the new institute with the necessary monetary contributions in proportion to the importance of the countries in the oil industry.

It is proposed that the membership be grouped in three different denominations.

The first of these would consist of protecting members, including the South American governments, the existing official institutions and national or private companies concerned with the exploitation of petroleum resources. This membership could contribute to the support of the South American Petroleum Institute in proportion to the importance of their country in the production of oil, following a procedure similar to the one which fixes the contributions of the members of the South American Congress of Railroads. The same procedure governing contributions could be followed in the case of official and private institutions of the oil producing countries and could be applied to refineries or commercial organizations for the sale of petroleum products. In the latter case the contribution could be arrived at on the basis of a fixed quota per barrel of petroleum refined or sold during the year.

The second classification would consist of active members among which would be listed the engineers, chemists and technical men affiliated with the actual petroleum industry in South America for the exploitation of oilfields, refineries, marketing and transportation and also those experts connected with the teaching of petroleum courses in private or official institutions and also experts connected with the administration of the petroleum industry on behalf of the government. Active members would be expected to subscribe a moderate fee to the support of the institute.

A third class of members would comprise subscribing members, among whom would be included all those persons who, without being technical experts, are engaged in rendering services to South American enterprises devoted to the petroleum industry in any of its three aspects already mentioned; i.e., exploitation of oilfields, refining and commercialization. This class of members would also subscribe a moderate fee for the support of the institute.



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Due to remote location of some of the South American fields large storage capacity must be maintained to assure optimum operation of the necessary pipelines

Due to the great distances involved on the South American continent, Vegh Garzon proposes that the institute be split up into several branches. For instance, one branch of the central institute might comprise the area of the Rio de la Plata consisting of the active members residing in Uruguay, Argentina, Bolivia, Paraguay and Southern Brazil. A second branch could be established on the Pacific which would consist of the active members residing in Chile, Peru and Ecuador. A third branch could be established for the Northern South American group, consisting of members from Colombia, Venezuela, and Northern Brazil. These branch groups could have meetings at shorter intervals than the annual meeting of the central institute. For example, such branch meetings could be held every six months or even more often, according to the available facilities for communication existing within the respective zone. The findings of the regional branches could be submitted at the yearly meetings of the central institute. In this phase of its organization, the South American Petroleum Institute would follow the procedure established in London by the Institute of Petroleum, which has given such excellent results and which would, according to Dr. Vegh Garzon, be perfectly adaptable to the South American continent.

In his proposal for the establishment of this institute, Vegh Garzon does not go into such phases of the organization as the constitution of the board of directors, the executive committee, the proposed location of the central organization or the detailed duties of the three classes of membership. Such matters he suggests might well be left to the committee for organization which will be appointed by the Board of Directors of the Union Sudamericana de Asociaciones de Ingenieros. Vegh Garzon proposes to the U. S. A. I. that an organization committee be appointed at the earliest opportunity and that this committee could be charged with the work of drafting a definite plan for the creation of the South American Institute of Petroleum, such plan to be submitted to the next Lima convention (January 1941). He further proposes that while this committee is carrying on the preliminary work of organization, the executive committee of the U. S. A. I. could distribute through the South American countries a prospectus of the proposed institute as outlined in Dr. Vegh Garzon's letter to the committee. This prospectus would then come under discussion in existing petroleum institutions in the various countries as well as by government officials concerned with the petroleum industry and by the experts affiliated with such institutions and such governmental departments. In order to facilitate the distribution of this prospectus, Dr. Vegh Garzon has submitted a list of the institutions and petroleum departments of the various South American countries and suggests that after they have had an opportunity to discuss the prospectus, they be requested at once to appoint delegates who could meet in Lima on the occasion of the U. S. A. I. convention in 1941.

Finally, Vegh Garzon expresses himself as completely at the service of the directorate of the U. S. A. I. for any purpose such as supplying further information in regard to plans for the formation of the South American Petroleum Institute and also expresses himself as entirely willing to undertake any task that the directorate might deem necessary for the organization of this project.

Field For Expanded Trade Between North and SOUTH AMERICA

Each Continent Capable of Using More of Others Products — Loss of European Markets Has Severe Restrictive Effect — U. S. Can Absorb Variety of Latin American Products.

NORMAL channels of South American trade were first sharply altered by the world-wide economic depression of the early thirties and as a result of the war in Europe were again violently dislocated within the past year. Today more than ever before events have served to emphasize the paramount importance of stimulating and increasing trade between North and South America, not only because many of the exportable products of the two continents are complementary in character, but also, and perhaps more significantly, these two continents constitute the principal remaining areas where normal commercial relations may exist without involving attempts at economic, commercial or political domination.

South America is an important producer and exporter of tropical foods, raw materials and minerals and is an important market for manufactured and semi-manufactured goods. While at present South America is more important in world commerce as a supplier of raw materials than it is as a market for manufactures, this condition may be expected to show a gradual change until shipments to and from the continent are in approximate balance.

The important fact in considering trade in relation to South America is that the continent stands more or less at the beginning of its development. While South America comprises 13 percent of the world's land surface, it has only four percent of the world's population. The continent is approximately two and one-third times the size of the United States, being some 6,952,000 square miles in area: its population, however, is just over 88,000,000 or 13 per square mile against the 130,000,000 people in the United States which works out to 41 persons per square mile.

Scarcity of population is aggravated by the fact that while the area is predominently agricultural and pastoral, a disproportionately large number of people are concentrated in relatively small areas. Buenos Aires, Rio de Janeiro and Sao Paulo are all cities of over 1,000,000 inhabitants.

South America is practically self-supporting in agriculture, although a considerable trade in agricultural produce between the various South American countries does exist. Moreover, South America exports, in addition to large quantities of tropical fruits, spices, tobacco, rubber, lumber, cotton, wheat and corn, nine-tenths of the entire world trade in coffee, one-half the world trade in flax seed, and one-third the trade of the world in both castor seed and cacao.

Nevertheless, the real importance of South America in world trade is based on her great mineral resources, and these, with the exception of precious metals, have hardly been developed. South America is the exclusive producer of natural nitrate; it is the principal producer of tin, platinum, manganese, bismuth and vanadium. Extensive coal deposits exist in various parts of South America, but that continent rates last in the production of this commodity; huge reserves of iron ore have been located but these too are relatively undeveloped.

The copper, tin, lead, zinc, manganese, gold and silver deposits have been extensively worked but like coal and iron ore, development has been somewhat retarded by location of the deposits coupled with lack of adequate transportation facilities and in some cases hesitancy of capital induced by political unstability. Petroleum and copper have received the most extensive development of any minerals in South America. Venezuela and Colombia for the past two decades have been important world suppliers of petroleum while Bolivia, Ecuador, Peru and Chile have held a leading place in copper supply. Chile, in fact, is said to be the possessor of the world's largest single deposit of copper and is second only to the United States in the quantity of this mineral produced.

South America is also an important source of chromium, molybdenum, mercury, cobalt, antimony, wolfram, mica and sulphur.

South American trade followed the course of world trade in an approximate manner over the last decade. Exports having reached a peak in 1929 declined sharply in 1932-33, reaching a low in the latter year. Since then there has been a substantial recovery. It is of interest to note that total South American exports never declined in relation to world exports as far as South American total imports declined in relation to world imports. Maintenance of export value at better levels than import values is the more remarkable in view of the fact that values of goods normally constituting South American exports declined more sharply on world markets than did values of the manufactured and semi-manufactured goods comprising the bulk of South American imports.

In 1929 South America as a whole exported goods to the value of $2,214,600,000 while importing goods to the value of $1,870,600,000, leaving a balance of $344,000,000 or 15.5 percent of the total export value; by 1932 the value of South American exports had dropped to $794,400,000 while the value of imports had dropped to $455,800,000 leaving a balance of trade in favor of South America of $338,600,000. The interesting fact here is that in 1932 the favorable balance amounted to 42.6 percent of total exports compared with 15.5 percent in 1929. It should also be noted that while value of South American imports dropped 76.1 percent between 1929 and 1932, exports dropped only 68.6 percent in value.

By 1937 value of total South American imports had recovered to 67.2 percent of the 1929 figure and stood at $1,257,300,000; value of total South American exports however, had recovered to 85.7 percent of the 1929 figure and stood at $1,898,300,000.

Numerous trade regulations have always been a feature of South American commerce. In many cases customs revenues constituted the major source of government revenue. During the depression the relatively sharper drop in the unit value of goods exported compared with goods imported resulted in a commercial policy that included practically every known type of trade control in one or another of the South American countries. In addition to the high customs duties already in existence, exchange and quota controls were adopted by nine of the ten South American countries. Bilateral trade agreements were entered into by Argentina, Brazil and Chile. Official valuations, only remotely related to world market prices, were used in Colombia, Venezuela and other countries. Export taxes and export subsidies were made use of to favor certain commodities and to derive revenue from others.

There is no immediate prospect that these artificial trade controls will be abandoned to any considerable extent in the future. A rising level of prices on world markets may indeed eliminate the necessity for some of the restrictions. Bilateral trade agreements which involved principally Germany, Italy and the United Kingdom have become ineffective, at least temporarily, as a result of the European conflict with its blockades and interference with commerce of the belligerents. However, chronic surpluses, the desire to encourage domestic manufacturing and the ever-present need for additional government revenue to meet the demands of expanded social welfare programs, will doubtless operate to encourage the retention of trade controls.

The effect of the European war on the trade of the South American countries is beginning to make itself felt to the extent that an attempt to determine the direction of this trend may now be justified. Germany and

Italy have been practically eliminated as markets for South American goods and also as suppliers of manufactures to South America. In the latter category, Germany occupied an important position; Italy, however, played a less important part as supplier of South American markets. Along with Germany and Italy a number of less important trade outlets have also been eliminated, such as France, Holland, Belgium, Czechoslovakia, Poland, etc. It should be borne in mind, however, that the loss of these markets cannot be measured by the full extent of the normal purchases of the countries involved because these countries may now be expected to obtain some

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South America imports from North America the machinery and equipment to develop her vast potential resources and make available further raw materials for export to North America. South Americans become proficient at operating even complicated tools in the machine shops set up to service the oil fields of Venezuela.

proportion of the supplies, formerly shipped by South America, from the countries of south eastern Europe and to that extent will eliminate the competition formerly offered by these southeastern European countries to shipments from South America. It must be considered that some part of the trade of war-eliminated nations has been actually lost and some part of it has been re-routed in a manner that will permit South America to supply larger quantities of goods to markets formerly supplied to some extent from southeastern Europe.

In addition to the loss of certain markets, the rationing of essential commodities by the Allies, German interference with shipping, and efforts on the part of England to conserve foreign exchange by trading with the sterling block and with units of her own empire, will also tend to reduce the market for South American raw materials. Against this trend toward reduced markets, may be placed the increased demand in Great Britain for meat, wool, copper and petroleum. The United Kingdom has, for example, greatly increased the purchases of Argentine beef in the early period of the war; sooner or later an increased demand for Venezuelan and Colombian petroleum must make itself felt. Increased prices for these commodities as well as for copper, resulting from war time demand may succeed in raising the value of South American exports to Europe, although it appears very unlikely that such increase in value will do more than partially off-set the considerable decline in volume of shipments. On the whole, it seems reasonable to anticipate a substantial falling off in the trade between Europe and South America.

In the light of this conclusion it becomes interesting to examine the position occupied by the United States in South American trade. In 1939 the United States took 13.5 percent of her total imports from South America. U. S. imports from South America were valued at $313,153,000. Of total U. S.

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Much of the equipment to be found in the world's largest oilfield on the shore of Lake Maracaibo in Venezuela has been designed and constructed in the United States.

exports, South America took 10.3 percent valued at $327,101,000. Following the outbreak of the European war, the United States imported $190,784,000 worth of South American goods in the first six war months (Sept. 1939-February 1940), an increase of 36.5 percent over the corresponding six months of 1938-39. In the same period, the United States exported goods to the value of $215,691,000 to South America, an increase of $79,172,000 or 57.9 percent over the corresponding period of 1938-39. In considering this latter figure for South American imports from the United States it is important to remember that this tremendous increase may be due in part to the experience gained in South America during the first world war when stocks of consumer goods were exhausted and replacements became for a while almost impossible to secure. In the face of that former situation South American countries may have stocked up far in excess of subsequent requirements and not until figures for the second and third six months periods of the war are available will it be possible to evaluate with any accuracy the extent to which loss of European sources of supply will be replaced by South American purchases in the United States.

Prior to 1939, 47.3 percent of total Latin American (as distinct from South American) exports went to the countries of the western hemisphere; 48.3 percent to Europe; and 4.4 percent to Asia, Africa and Oceania. Forty-six percent of all Latin American (as distinct from South American) imports originated in the western hemisphere; 48 percent originated in Europe; and six percent in Asia, Africa and Oceania. These are the figures that may be expected to undergo profound changes; it may be confidentially anticipated that the immediate future will show a very marked decline in the percentage of South American shipment to and from Europe and a roughly corresponding increase in the percentage of shipments within the western hemisphere.

Petroleum is one of the most important products exported from South America. In order of importance, the oil producing countries of South America are: Venezuela, Colombia, Argentina, Peru, Ecuador and Bolivia. Crude oil production for South America for the past five years is shown in the accompanying table. Production of individual South American countries in relation to the producing countries of the rest of the world is shown in the regular crude oil production tables on pages 84-85 of this issue.

South American Crude Oil Production 1935-1939

	South American Production	South American Percent of World Production
1935	199,656,000	12.1
1936	209,125,000	11.6
1937	244,071,000	12.0
1938	245,359,000	12.4
1939	262,435,000	12.6

While South America has varied little in the last five years in its production relative to the rest of the world, its importance in international trade in petroleum is much greater than is indicated by the 12 percent of world production for which it is responsible. In 1938 South America exported 35.5 percent of the entire world exports of petroleum. With the exception of Argentina and Bolivia, the other South American countries produce far more than they require, consumption being of the order of 10 or 15 percent of production. The accompanying table gives an idea of the relative importance of the various exporting countries.

Petroleum and Products Exported in 1938 by Countries in Order of Importance

Exporting Country	Bbl.
United States	185,492,000
Venezuela	185,126,000
Iran	67,312,000
Netherland India	45,026,000
Roumania	34,424,000
Iraq	30,955,000
Colombia	18,453,000
Trinidad	16,383,000
Mexico	13,803,000
Peru	13,135,000
U. S. S. R.	4,916,000
Ecuador	1,686,000
Argentina	541,000
World Exports	617,252,000
of which South American Exports are 35.5 percent.	218,941,000

Of the petroleum and products exported from South America fully 90 percent is crude oil. The leading markets for this oil in 1938 were the United Kingdom, France, Canada, Germany and Japan. Consideration of the present status of those countries indicates the extent of the loss of market sustained by the South American oil exporting countries. Shipments to the United Kingdom have been cut down drastically as a result of rationing of all but military requirements; no oil is at present entering France from South America as a result of the British blockade, nor is any oil from this source being shipped to Germany; Canada may be expected to continue and even enlarge its imports from

South America, but the quantities recently purchased in South America by Japan have been insignificant.

In reviewing statistics on South American oil shipments it is necessary to bear in mind that while the Dutch West Indies (Curacao and Aruba) appear as the world's largest importer of crude and as one of the world's three largest exporters of oil, this is due to the location of two of the world's great refineries on these islands. Actually the Dutch West Indies represent a small market for petroleum and should be considered for the purpose of oil trade statistics as an economic unit with Venezuela on one hand and Colombia on the other.

Tariffs and trade barriers of various kinds existed in Europe prior to the outbreak of war: in addition to trade restrictions, South American petroleum had to meet the competition of petroleum produced in Iraq, Iran, and Bahrein, as well as Roumanian oil and surplus crude and products shipped from the United States. The situation has now been somewhat simplified as no South American crude reaches continental Europe, and the United Kingdom remains as the principal market in that section of the globe.

In the western hemisphere Canada takes substantial quantities of petroleum from South America, crude being admitted duty free. Refined products are dutiable however, and empire products receive a tariff preference.

The other important market in this hemisphere is the United States. Principal trade barrier is the import excise tax which became effective in 1932 and which imposes a tax of ½ cent per gallon on crude, ½ cent per gallon on fuel oil and gas oil, 2½ cents per gallon on gasoline and four cents per gallon on lubricating oils. This tax has subsequently been modified as a result of the reciprocal trade treaty with Venezuela, and through the most favored nation clause, as regards Colombia also. This treaty reduces the tax on imported Venezuelan and Colombian crude from ½ cent per gallon to ¼ cent per gallon but is limited in quantity to five percent of the domestic crude run to still in the United States during the preceding year (a quota of approximately 60,000,000 bbl. for 1940). Due to the location of Colombia and Venezuela, it has proved economically feasible in the past to import heavy fuel oil, or crude containing heavy fuel oil fractions to the eastern seaboard of the United States as shipping costs are more attractive than rates from Texas Gulf Coast ports. It is, however, unlikely that the quantity imported, even with the trade treaty will exceed by any substantial amount the 60,000,000 to 65,000,000 bbl. that will be entitled to the ¼ cent preference.

In 1938 Venezuela exported a total quantity of 185,126,000 bbl. of petroleum and products of which 12.3 percent went to the United States. A quantity of 150,155,000 bbl. was shipped to the Dutch West Indies and may be assumed ultimately to have found its way to European markets. In addition, 4,182,000 bbl. were shipped direct from Venezuela to the United Kingdom, 2,303,000 bbl. were shipped to France, 1,791,000 bbl. to Canada and 3,854,000 bbl. to other countries, principally in South America. Some 22,841,000 bbl. of oil were shipped to the United States.

Colombia which ships no refined products outside the country, exported a total of 18,453,000 bbl. of crude in 1938. Of this the greatest quantity went to the Netherlands West Indies, some 8,470,000 bbl. most of which eventually reached European markets. Thirty-two percent (6,035,000 bbl.) went to Canada, 2,813,000 bbl. to France, 733,000 bbl. to Italy, 83,000 bbl. to Argentina and 319,000 bbl. to other countries. No oil was shipped to the United States in 1938 although as recently as 1932, 71.2 percent of all Colombian exports were taken by the United States.

Peru, shipping 13,135,000 bbl. in 1938, destined her largest shipment for Argentina which country took 3,333,000 bbl. No oil was shipped to the United States. France was the second largest purchaser, taking 2,306,000 bbl. Canada took 1,727,000 bbl., Germany 989,000 bbl. Some 2,202,000 bbl. were shipped from Peru, either direct to Europe or by way of the West Indian refineries; the balance went to various South American countries.

Ecuador likewise shipped no oil to the United States, 304,000 bbl. going to United Kingdom, 199,000 bbl. going to France and 190,000 bbl. to Japan. The remaining 989,000 bbl. went to Uruguay, Brazil and other South American countries.

Finally, Argentina which produces only about 50 percent of her own market requirements, exported a total of 541,000 bbl. in 1938. Of this 2.2 percent, or 12,000 bbl. went to the United States. The United Kingdom received 239,000 bbl., France, 150,000 bbl., Germany, 25,000 bbl., Norway 17,000 bbl. and Italy 16,000 bbl. The balance went to nearby South American countries.

With the vast potential production now available in the United States, it is obvious that this country will not be in a position to serve as a relief outlet for increasing quantities of South American oil, at least in the immediate future. With Europe, except for England blocked off from South American shipment, little relief may be looked for from that quarter. While England may require increased quantities of petroleum, such increase will scarcely compensate for the loss of the rest of the European market. Japan, principal consumer in the East, looks to Netherland India for her supplies. During the war at least it may be anticipated that South American production will have to be closely held in if overheavy stocks are not to destroy petroleum values when channels of international trade are opened at the close of hostilities and the reconstruction of vast areas of Europe creates a substantial demand for South American oil.

(Grateful acknowledgment is hereby made to the U.S. Tariff Commission for most of the statistical material appearing in this article.—Edit.)

Water for the boilers of a wildcat rig is more of a problem in Eastern Venezuela than in the Lake shore drilling of the West: here it is being solved with U.S. equipment.

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NEW REFINING PROCESS Permits Higher Conversion Per Pass

By Povl Ostergaard[1] and Dr. Eugene R. Smoley[2]

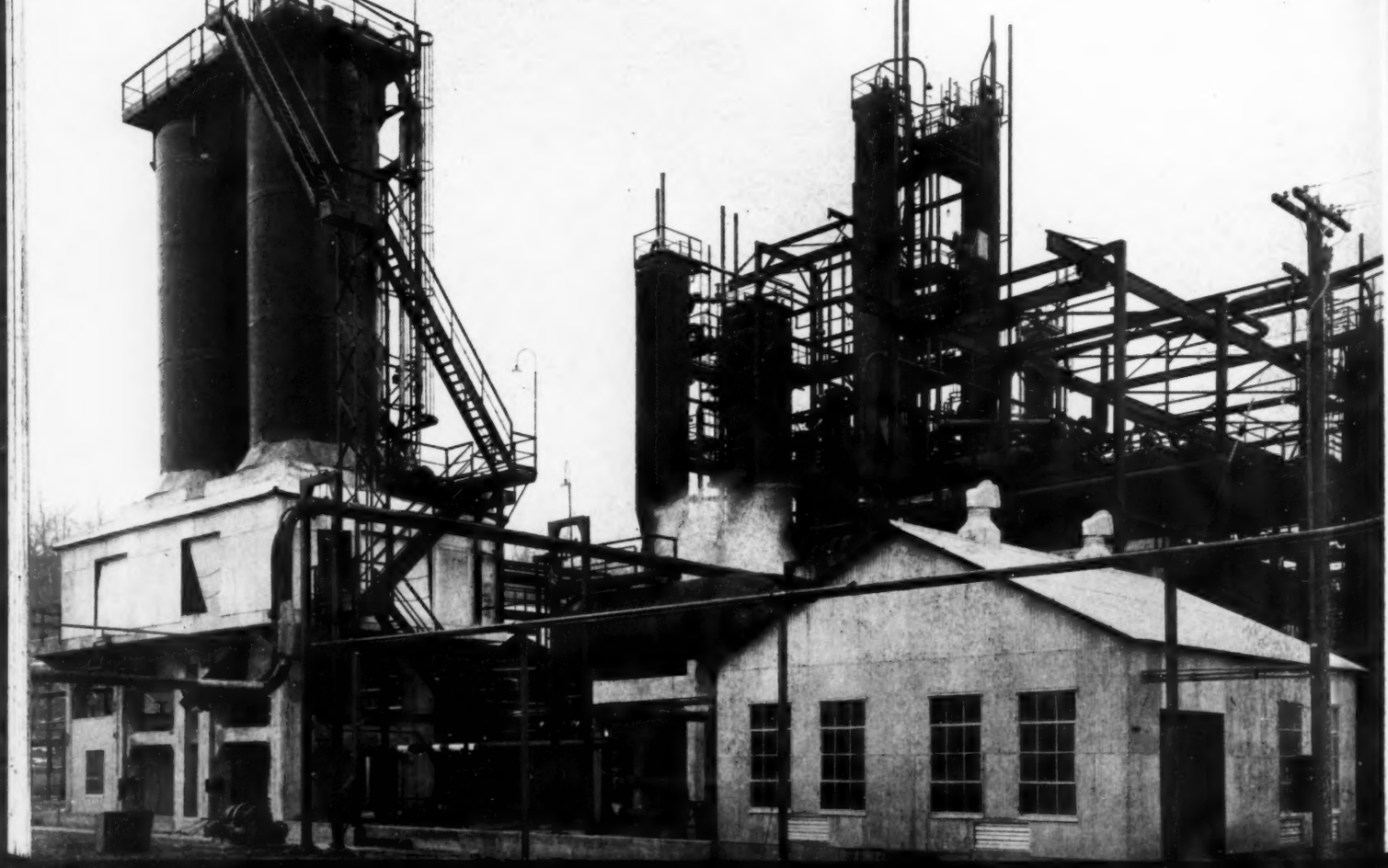
High Yields of High Octane Gasoline with Superior Lead Susceptibility and Blending Qualities Suggest Wide Use of Gulf Polyform Process.

THE ever increasing demand for more gasoline, and for higher octane number, has made it necessary for the oil industry to explore all possibilities for increasing the yield of gasoline from crude in existing installations and improving the yield and the quality of gasoline by new refining methods.

One of the recent accomplishments in the refining industry is the development of the Polyform Process by the Process Division of the Engineering, Construction, & Process Department of the Gulf Oil Corporation. The Polyform Process differs from the ordinary thermal cracking process in that the oil is processed in admixture with varying amounts of normally gaseous hydrocarbons, particularly propanes and butanes, and in that the oil is subjected, in such admixture, to higher temperatures and higher degrees of conversion per pass than would be possible, under otherwise similar conditions, without excessive coke formation in the cracking tubes. The process results in the production of gasoline in higher yield and of higher octane value than can be obtained by subjecting the same oil to a conventional thermal cracking operation.

The Lummus Company now offers this Polyform Process to the refining industry. The Polyform Process has been used in large scale operation in the plants of the Gulf Oil Corporation for over four years with routine refinery runs of 1,500 to 2,500 hours on stream. At present there are five polyform units in regular refinery operation with oil charge capacities ranging from 1,500 to 22,000 bbl. per day. The Lummus Company is at present engaged in the construction of two large naphtha polyform units for the production of 10,000 bbl. and 4,000 bbl. per operating day of 76 to 77 C. F. R.-A. S. T. M. octane number gasoline from heavy naphtha and outside propanes and butanes. The larger unit is being purchased by a major oil company and will be located on the Gulf Coast; the other unit is for the Gulf Oil Corporation.

With the present trend for higher octane gasoline requirements, the polyform process is of real interest to the refining industry as it offers an economical means of increasing yield and raising the octane number of gasoline from any refinery and any type of charging stock. It can replace with better results all types of thermal cracking operations including reforming, gas oil cracking, vis.—breaking, coking, or complete combination crude cracking. It is possible to convert 20-30 C. F. R.-A. S. T. M. octane number naphtha stock, with a boiling range of 250 deg. F. to 450 deg. F. to 76-82 C. F. R.-



Naphtha polyform unit with coke drums, in Gulf Oil Corporation's Cincinnati refinery.

[1] Engineering, Construction, & Process Department, Gulf Oil Corporation.
[2] The Lummus Company.

A. S. T. M. octane number gasoline with high yields. From a whole crude, such as Mid-Continent, East Texas, or West Texas, it is possible to obtain three to four percent higher overall gasoline yield of 72-74 C. F. R.-A. S. T. M. octane number. The fuel gas produced varies from .70 to .85 specific gravity, free of butanes and containing only 2-15 percent propanes. Polyform gasolines have high octane numbers with road octane appreciation of from three to eight numbers, appreciation from C. F. R.-A. S. T. M. octane to Research Octane of 9 to 14 numbers, high blending values, excellent distillation characteristics, and good lead susceptibility.

The polyform distillate offers no additional treating problems. Clay treating and sweetening, or acid treating, rerunning, and sweetening, depending upon sulfur content, are conventional. A small amount of gum inhibitor is added for gum stability.

By a modified operation the naphtha polyform process can be conducted to yield a distillate of approximately 80-84 octane number CFR-ASTM. This distillate has a very high aromatic content of from 20 percent to 35 percent which is predominantly toluenes and xylenes. By cold acid treating and rerunning, this high octane polyform distillate can be processed to yield approximately 40 percent of 77-79 octane CFR-ASTM aviation gasoline of satisfactory boiling range, acid heat, and stability, which will lead up to 90 CFR-ASTM octane number with less than 3 cc. T. E. L. Besides the aviation gasoline cut, a 35 percent cut of aviation gasoline safety fuel with an octane number of 80 CFR-ASTM can be produced with properties as indicated later in the text. The balance of 25 percent is treating and polymer loss.

While the development of the polyform process represents a distinct departure from prior practice, polyform units are simple in design, and offer no greater operating problems than conventional thermal cracking units, as the plant equipment consists of pumps, heaters, fractionating towers, heat exchangers, etc., with all of which any cracking coil operator is thoroughly familiar. The instrumentation of these units allows complete automatic control of oil levels, pressures, temperatures, flow rates, etc., leaving to the operators supervision and fine adjustments for optimum results. Investment costs and utility requirements are only slightly higher than for conventional cracking units. The slightly higher costs are due to higher operating temperatures and pressures used in polyform operations.

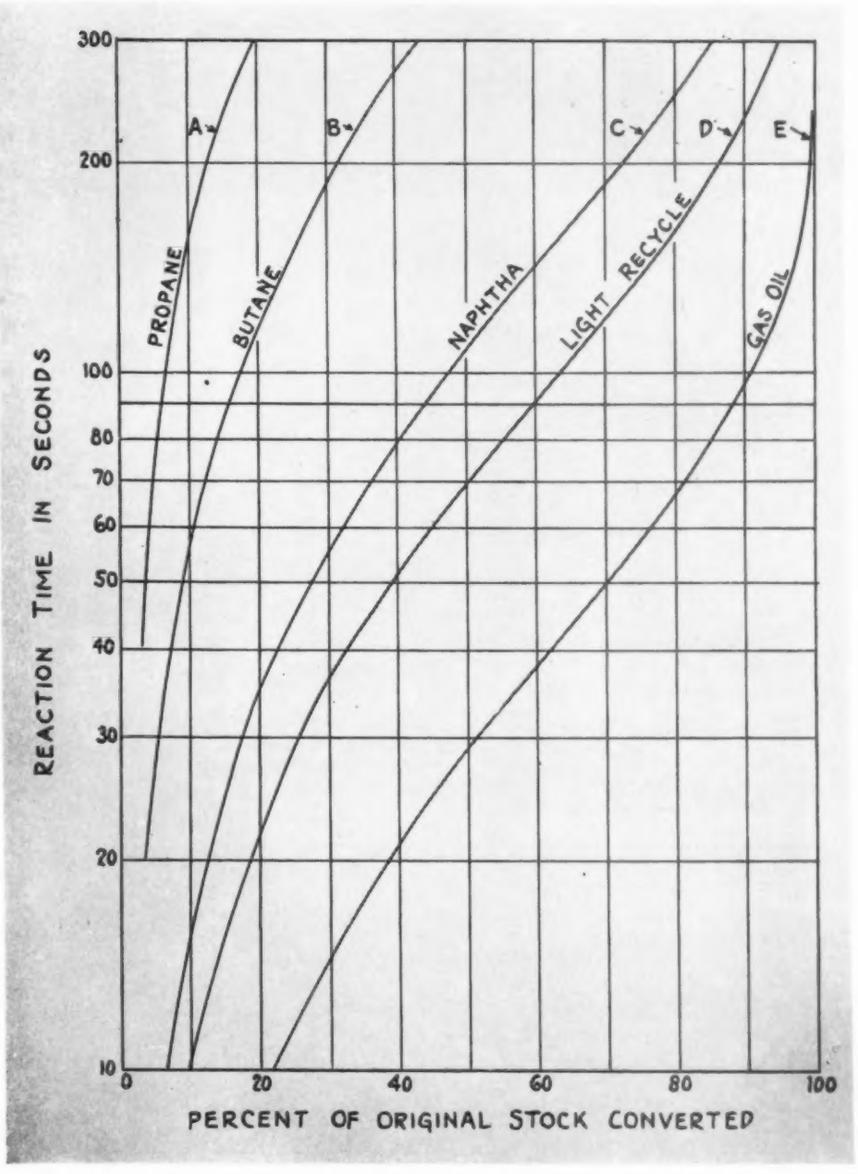


Figure 1: Relative cracking rates of different stocks at 1020 deg. F.

All oil cracking operations represent a compromise between yield and product quality. More drastic cracking of relatively heavy stocks tends to result in higher yields of gasoline while more drastic cracking of light stocks such as naphtha tends to reduce the yield of gasoline. It is known that the octane number of gasoline rises with the degree of conversion per pass, and that the reaction velocity of cracking rises sharply with temperature. More intense cracking ordinarily tends to increase the yield of normally gaseous hydrocarbons.

Inasmuch as the octane number or anti-knock value of the final cracked gasoline from any given stock is largely a function of the

TABLE NO. 1

Comparison of Crack Per Pass
(400 E. P. Gasoline by Volume)
Polyform vs. Conventional Thermal Cracking

Properties	Venezuela Reduced Crude		Mid-Continent P. S. Stock		Venezuela Recycle Stock		Mid-Continent Naphtha	
Gravity: deg. A. P. I.	19.3		26.0		27.1		50.0	
Assay Distillation								
Over Point: deg. F.	238		265		250		270	
10 percent at	496		451		424		302	
50 percent	715		626		522		336	
90 percent	1015		.....		664		378	
Mol. Weight	284		270		201		125	
Characterization Factor	11.0		11.5		11.1		11.8	
Vol. percent Liquid Gas C_3+C_4	None	25	None	53.8	None	44.2	None	49.2
Cracking Temperature, deg. F.	840	890	900	985	950	1000	1000	1030
Pressure lbs. per sq. in. Ga.	500	600	200	750	500	1000	1100	1100
Maximum percent Gasoline/Pass	9.0	15	18	41.3	16.3	30.5	70.1	77.2
Octane No. Gasoline	64.0	68.0	65.0	70.0	72.0	78.0	71.7	75.1

This data from commercial units with 2,000 hour average length runs.

TABLE NO. 2

	Naphtha Polyforming			Naphtha Polyforming With Outside Gas Feed Charging	
	Eastern Venezuela Naphtha 18.6-28.5% On Crude	West Texas Straight Run Gasoline 25% on Crude	50-50 Mix MC & Pa. Naphtha 24-34% On Crude	50-50 Mix MC & Pa. Naphtha 24-34% On Crude	MC Naphtha 20-32% On Crude
Yield Data—Volume Percent of Naphtha					
Charge					
Naphtha	100.0	100.0	100.0	100.0	100.0
Outside Gas Feed, F. O. E.	.....	.....	.....	57.4	83.8
Total Charge	100.0	100.0	100.0	157.4	183.8
Products					
Residue Gas, F. O. E.	9.0	14.3	15.1	59.0	80.7
Cracked Distillate	83.9	80.1	77.2	96.7	95.3
Residuum	7.4	2.6	7.8	9.7	9.2
Total Products	100.3	97.0	100.1	165.4	185.2
Outside Gas Feed, CF/B Chg.	None	None	None	2.090	2.820
Residue Gas, CF/B Chg.	506	728	651	2.565	3.200
Laboratory Inspection					
Naphtha					
Gravity: deg. A. P. I.	47.9	58.2	50.8	49.2	50.2
Aniline Point: deg. F.	136	132	141		137
Sulfur, L: percent	0.03	0.22	0.06		0.04
Distillation, A. S. T. M.					
Over Point: deg. F.	266	96	205	219	156
End Point: deg. F.	431	415	433	451	494
10 percent at: deg. F.	290	170	300	290	244
50	311	266	345	342	345
90	372	374	395	412	439
Octane No.: CFR-ASTM, Clear	47.3	48.5	33.0	33.2	33.1
Stabilized Distillate					
Gravity: deg. A. P. I.	52.0	57.8	56.7	56.0	59.2
Acid Heat: deg. F.	89	95	113	103	100
Aniline Point: deg. F.	71	81	70	83	91
Sulfur, L: percent	0.01	0.05			
Vapor Pres., 100 deg. F.: P. S. I.	8.2	9.7	11.5	10.1	11.1
Distillation, A. S. T. M.					
Over Point: deg. F.	100	93	95	86	86
End Point: deg. F.	404	410	412	424	420
10 percent: deg. F.	152	122	120	119	120
50	282	211	264	241	225
90	349	337	368	378	372
Octane No.: CFR-ASTM, Clear	76.1	75.9	75.1	76	76.5
Octane No.: CFR-Research, Clear	86.4	86.9	87.1	86.5	87.0
Residuum					
Gravity: deg. A. P. I.	22.9	4.2	10.5	12.7	7.4
Viscosity, S. U. V.: 100 deg. F.	41	8140	75	75	3008
Sulfur, B: percent	0.13	0.16	.....	.....	0.1
Water and Sediment percent	0.2	0.1	0.2	0.1	0.1
Outside Gas Feed					
Podbielniak Analysis: Mol. percent					
Hydrogen	.....	.....	.....	2.5	2.5
Methane	.....	.....	.....	37.4	34.9
Ethane	.....	.....	.....	20.4	18.8
Ethene	.....	.....	.....	2.2	3.5
Propane	.....	.....	.....	18.6	18.9
Propene	.....	.....	.....	7.5	8.5
Butanes	.....	.....	.....	5.0	6.7
Butenes	.....	.....	.....	4.0	4.8
Pentanes	.....	.....	.....	1.7	1.1
Hexanes and Heavier	.....	.....	.....	.....	0.3
Hydrogen Sulfide: Mol. percent	.....	.....	.....	0.2	0.3
Total Unsaturates: Mol. percent	.....	.....	.....	14.4	17.2
Specific Grauity, Air = 1.0	.....	.....	.....	1.077	1.120
Residue Gas					
Podbielniak Analysis: Mol. percent					
Hydrogen	7.0	6.8	16.9	7.0	7.0
Methane	54.7	53.0	34.1	41.9	39.9
Ehane	25.6	26.4	26.7	23.9	24.2
Ethene	9.7	8.6	5.0	3.5	4.8
topane	2.0	1.8	13.5	17.2	17.4
Propene	1.0	0.5	3.8	5.1	4.9
Butanes	.....	2.4	.....	0.9	1.0
Butenes	.....	.....	.....	0.5	0.8
Hydrogen Sulfide: Mol. percentn	.....	0.5	.....	0.2	0.3
Total Unsaturates: Mol. percent	10.7	9.1	8.8	9.1	10.5
Specific Gravity, Air = 1.0	0.700	0.770	0.86	0.906	0.935

degree of conversion per pass, it is of course desirable to operate at as high a degree of conversion per pass as possible, providing the yield and quality in other respects of the gasoline product are satisfactory.

The yields and octane numbers which can be secured from any given cracking stock depend naturally, to some extent, on the design of the still, but for any stock there is a definite crack-per-pass which cannot be exceeded without serious deposition of coke in the cracking coil.

The ordinary thermal cracking process, therefore, has definite limitations in magnitude of yields and octane numbers obtainable.

Any process by which the crack-per-pass can be increased means higher octanes and greater yields of light products. The gasoline yield can be further increased by converting part of the gases produced to gasoline hydrocarbons. The polyform process does exactly this.

Gaseous hydrocarbons, such as C_3 and C_4 hydrocarbons are introduced to the polyforming coils with oils for two purposes:

1. In order to effect a higher degree of conversion of the oil when diluted with C_3 and C_4 hydrocarbons than is possible when this oil is cracked by itself.

2. For the purpose of simultaneous cracking of the oil to a higher degree of conversion than is possible when the oil is cracked by itself, and at the same time to effect a certain amount of cracking with subsequent polymerization and other side reactions of the C_3 and C_4 hydrocarbons and oils.

While it is true that there will always be a small amount of cracking of the C_3 and C_4 hydrocarbons in any case, the conversion per pass of these components at temperatures below 950 deg. F. is so small that it may be said that the simultaneous cracking of the oil and polymerization of the C_3 and C_4 hydrocarbons can only be practically effected with oils which can be cracked at temperatures above 950 deg. F. For oils which cannot be cracked at these high temperatures the C_3 and C_4 hydrocarbons are primarily introduced in order to increase the crack-per-pass of the oil, and permit other side reactions. That favorable side reactions take place when polyforming heavier oils is substantiated by the very large volume increase of products over charge, which is of the order of two to three times the volume increase encountered in thermal cracking.

With respect to heavy oils such as reduced crudes, heavy recycle oils, etc., there is a definite minimum percentage of C_3 and C_4 hydrocarbons in the total furnace feed which should be maintained in order to make possible the increase of the crack-per-pass of the oil. The minimum quantity of C_3 and C_4 hydrocarbons in the furnace feed is indicated to be related to the critical temperature of the furnace feed. It has been found that when cracking a mixture of an oil and C_3 and C_4 hydrocarbons at temperatures lower than the critical temperature corresponding to the mixture of the oil and the C_3 and C_4 hydrocarbons this oil cannot be subjected to more severe cracking conditions than if the oil were cracked alone. This is attributed to the following conditions.

When the temperature of an oil in a cracking tube is below the critical temperature of the oil and above its critical pressure there always exists a vapor phase and a liquid phase in the tube. The liquid phase is suspended in the vapor phase as minute oil particles which,

TABLE NO. 3

Properties of Various Percentages of Straight Run Gasolines and Naphthas from Eastern Venezuela Crude

Percentage on Crude	Total Gasoline 28.5	St. Run Gasoline 23.5	Naphtha 23.5 to 28.5	St. Run Gasoline 18.5	Naphtha 18.5 to 28.5	St. Run Gasoline 13.5	Naphtha 13.5 to 28.5
Gravity: deg. A. P. I.	60.5	64.6	45.7	68.5	47.9	72.8	50.8
Vapor Pressure at 100 deg. F.	9.6	.....	.....	.....	.....	15.2	.....
Aniline Point: deg. F.	120	121	126	124	136	127	116
Acid Heat: deg. F.	3	4	3	5	2	7	2
Sulfur: percent	0.01	0.01	0.05	0.01	0.03	0.01	0.01
A. S. T. M. Distillation							
Over Point: deg. F.	101	94	318	90	266	85	230
End Point: deg. F.	412	298	465	270	431	248	412
10 percent at deg. F.	158	136	329	128	290	119	258
50 percent	240	205	349	185	311	172	286
90 percent	342	270	409	242	372	213	358
Octane No. CFR-ASTM	59.9	64.3	40.9	67.0	47.3	71.1	49.7

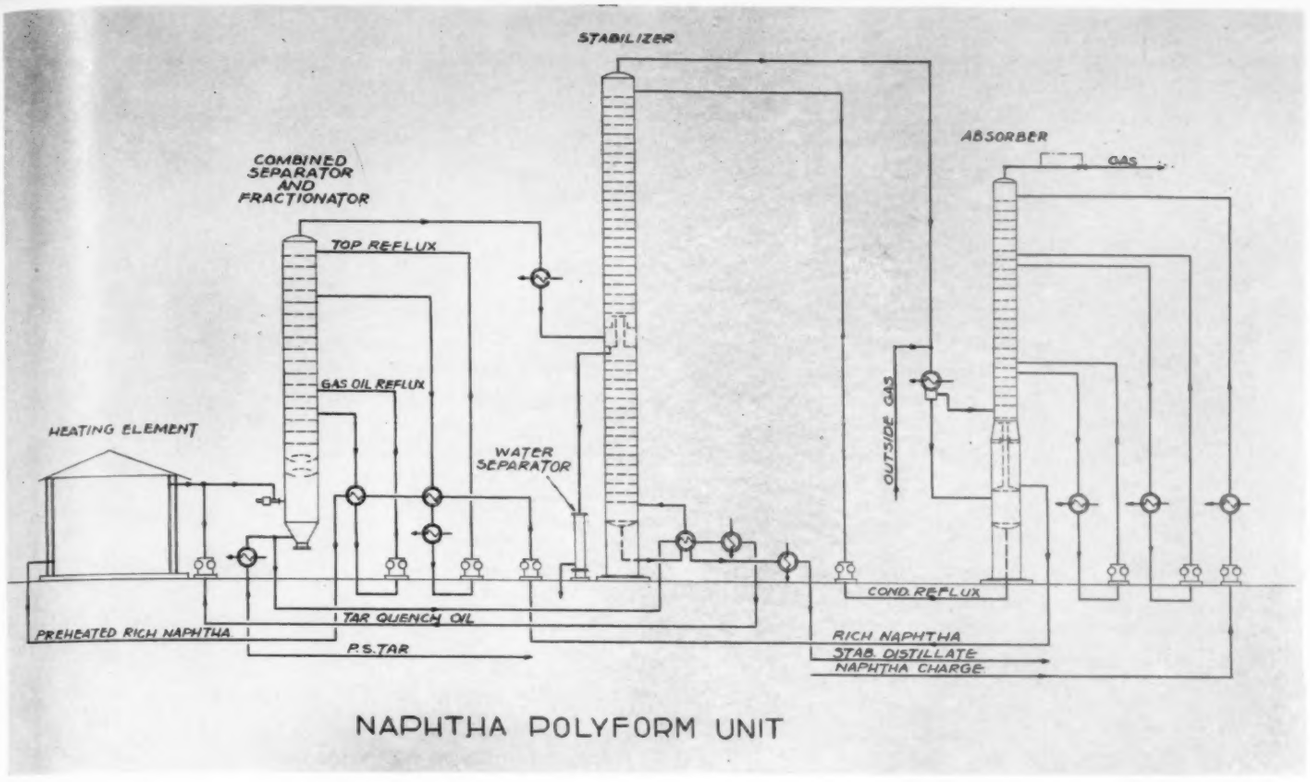


Figure 2: Naphtha polyform unit.

due to the turbulence in the tube, are thrown out against the tube walls covering them with a thin oil film composed of the heavier components of the oil.

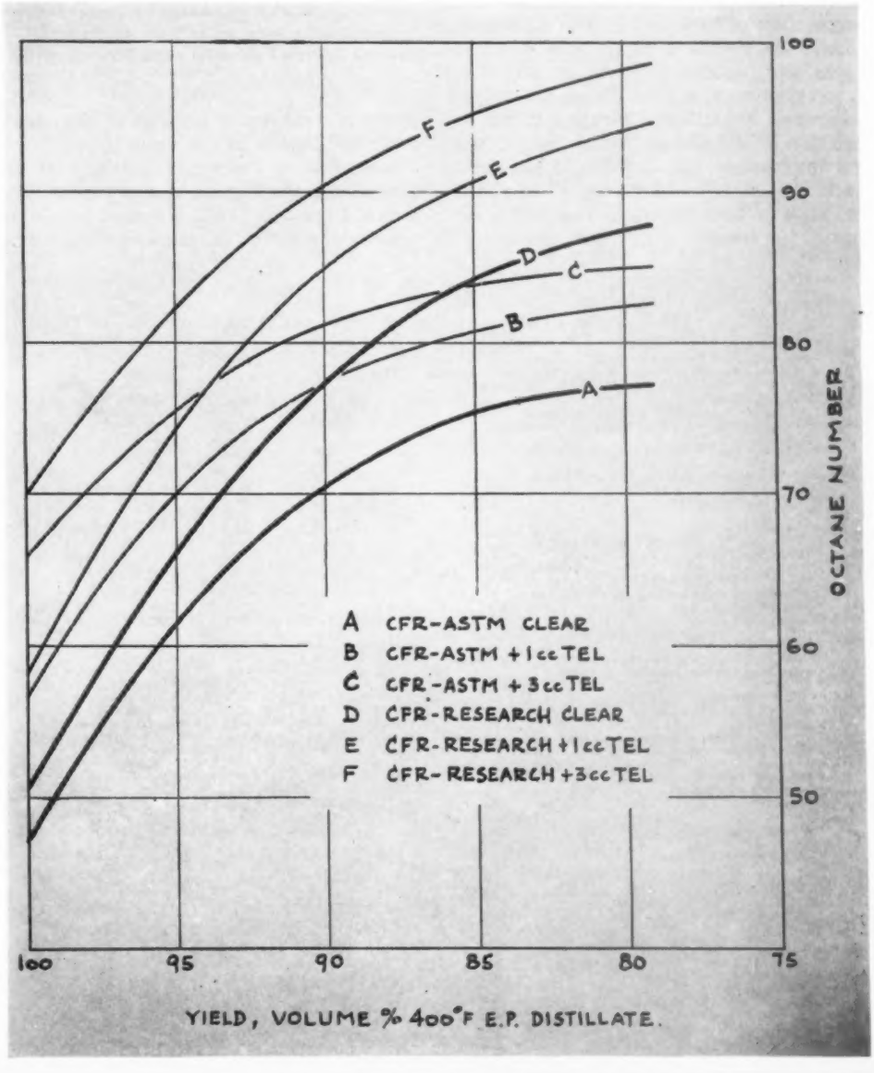
As the heat transmitted through the tube wall to the mixture of vapor and oil in the tube has to be transmitted through the oil film the coking characteristics for this mixture are determined by the coking characteristics for the oil film in the tube. As long as this oil film exists, gas dilution of the oil will not make it possible to crack the oil to a more severe degree than if the oil were there by itself. However, as the percentage of C_3 and C_4 hydrocarbons in the furnace feed is increased a point is finally reached where the critical temperature of this mixture is equal to the temperatures at which the oil can be cracked by itself. At this point only one phase exists, namely, a vapor phase. The oil vapors and the C_3 and C_4 hydrocarbon vapors will therefore form a perfect solution and the film on the tube wall will be of the same composition as the composition of the main body of hydrocarbon vapors passing through the tube.

Before the right percentages of dilution are reached there is no benefit in cracking the heavier oils in a dilution of normal gaseous hydrocarbons.

From the above discussion it is evident that there exists an absolute minimum limit for C_3 and C_4 hydrocarbon dilution of a heavy oil in order to effect an increase in the cracking conditions to which this oil can be subjected. On the other hand, there is also a maximum limit for the dilution of any oil with C_3 and C_4 hydrocarbons, in this case determined from the cracking, polymerization, and other side reactions of the C_3 and C_4 hydrocarbons recycled with the oil.

Figure 1 indicates a plot showing the relative percentage of conversion of propane, butane, virgin straight run Mid-Continent naphtha and light recycle gas oil when cracked at a temperature of 1020 deg. F. and a pressure of 1000 lbs. per sq. in. at different

Figrue 3: Yield-octane relationship from Eastern Venezuela naphtha polyforming.



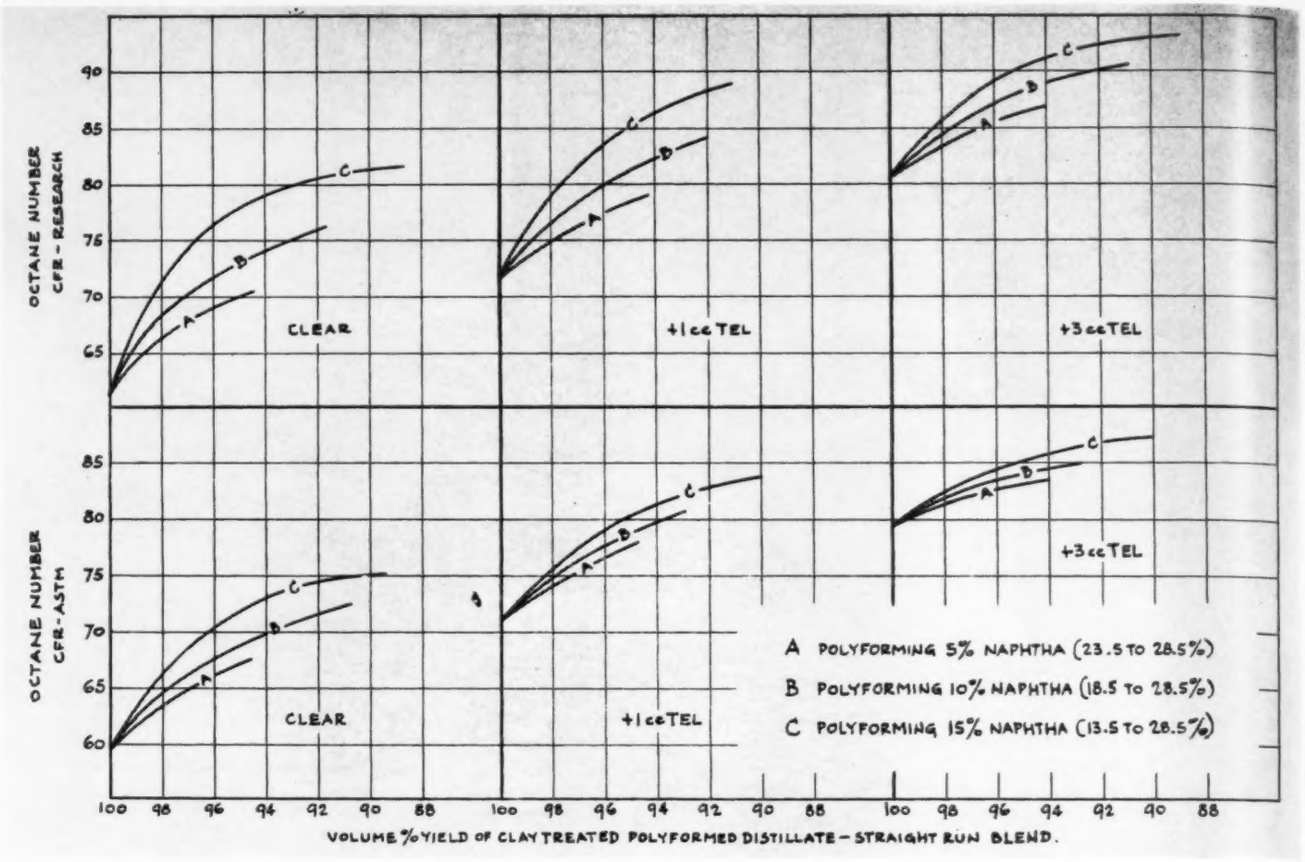

OCTANE NUMBER CFR - RESEARCH
OCTANE NUMBER CFR - ASTM
CLEAR
+1 cc TEL
+3 cc TEL
A POLYFORMING 5% NAPHTHA (23.5 TO 28.5%)
B POLYFORMING 10% NAPHTHA (18.5 TO 28.5%)
C POLYFORMING 15% NAPHTHA (13.5 TO 28.5%)
VOLUME % YIELD OF CLAY TREATED POLYFORMED DISTILLATE - STRAIGHT RUN BLEND.

Figure 4: Yield-octane relationship of blends of varying percentage of undercut straight run gasoline with clay treated polyformed complement naphtha from an original charge of 28.5 percent Eastern Venezuela straight run gasoline.

soaking times, expressed in seconds. The temperature of 1020 deg. F. was arbitrarily selected to permit a comparison of these stocks. For naphtha polyforming, 1030 deg. F. to 1130 deg. F. is generally used.

From an inspection of Figure 1 it will be seen that by subjecting propane and butane and the straight run naphtha to the same cracking conditions of 1020 deg. F. and 1000 lbs. pressure simultaneously with a soaking time of 150 seconds, the naphtha will be subjected to a conversion per pass of 60 percent while the butane at the same time will be subjected to a conversion per pass of 25 percent and the propane to a conversion per pass of 10 percent. If it is desired to reform the naphtha and at the same time crack and polymerize the C_3 and C_4 hydrocarbons it is evident that it will be necessary to maintain a cycle ratio of butane circulating through the heating element to fresh butane introduced to or formed in the system of 4:1 and a cycle ratio of the propanes charged to the furnace over fresh propane introduced to or formed in the system of 10:1.

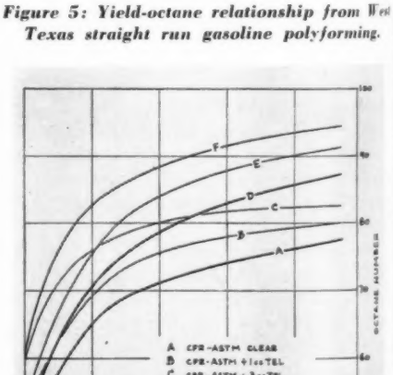
Likewise, if a less refractory oil as, for instance, virgin gas oil or light recycle stock, is to be cracked, and it is desired at the same time to crack and polymerize C_3 and C_4

TABLE NO. 4

Yield Data from Coking Section of Polyform Coking Unit

YIELD DATA	1	2	3	4	5
Charge—Volume Percent of Total Charge					
Residuum from Vis-Breaking and Clean Oil Cracking	92.3				
Residuum from Black and Clean Oil Cracking		88.6			
Reduced Mid-Continent Crude			92.3	94.5	
"A" Grade Asphalt from Mid-Continent Crude					91.7
Residuum from Naphtha Polyform Operation	7.7	11.4	7.7	5.5	8.3
Total Heavy Oil Charge to Coking Section	100.0	100.0	100.0	100.0	100.0
Products—Volume Percent of Total Crude					
Residue Gas	15.8	22.3	14.3	10.4	14.5
Polyformed Distillate	16.5	15.7	28.6	27.2	22.0
Gas Oil	41.5	28.6	45.0	50.3	44.8
Coke (400 lbs./bbl.)	29.1	33.0	15.6	15.4	22.4
Total Products	102.9	99.6	103.4	103.3	103.7
LABORATORY INSPECTION					
Outside Heavy Oil Charge					
Gravity: deg. A. P. I.	10.2	9.9	21.8	22.0	16.1
Viscosity, SUV at: 100 deg. F.	2,294	1,367	1,361	1,232	
: 210 deg. F.	101				689
Pour: deg. F.	+20	+20	+40	+65	+60
Water and Sediment: percent	0.4	0.1	0.2	0.1	0.1
Conradson Carbon Residue: percent	11.3	8.6	4.6	4.6	8.4
Gas Oil Produced					
Gravity: deg. A. P. I.	17.8	14.3	25.7	27.1	24.5
Pour: deg. F.	+20	+30	+35	+50	+40
Conradson Carbon Residue: percent	0.09	0.15	0.08	0.08	0.18
Aniline Point: deg. F.	82	60	135	143	121
Distillation, A. S. T. M.					
Over Point: deg. F.	466	452	458	440	435
10 percent at: deg. F.	508	522	521	513	498
50 percent	587	598	616	618	604
70	671	640	661	666	668
Coke					
VCM: percent	10.8	9.7	13.1	9.0	10.8

Figure 5: Yield-octane relationship from West Texas straight run gasoline polyforming.


A CFR-ASTM CLEAR
B CFR-ASTM +1 cc TEL
C CFR-ASTM +3 cc TEL
D CFR-RESEARCH CLEAR
E CFR-RESEARCH +1 cc TEL
F CFR-RESEARCH +3 cc TEL
OCTANE NUMBER
% 400-410° F. E.P. - 10 LB. R.V.P. DISTILLATE

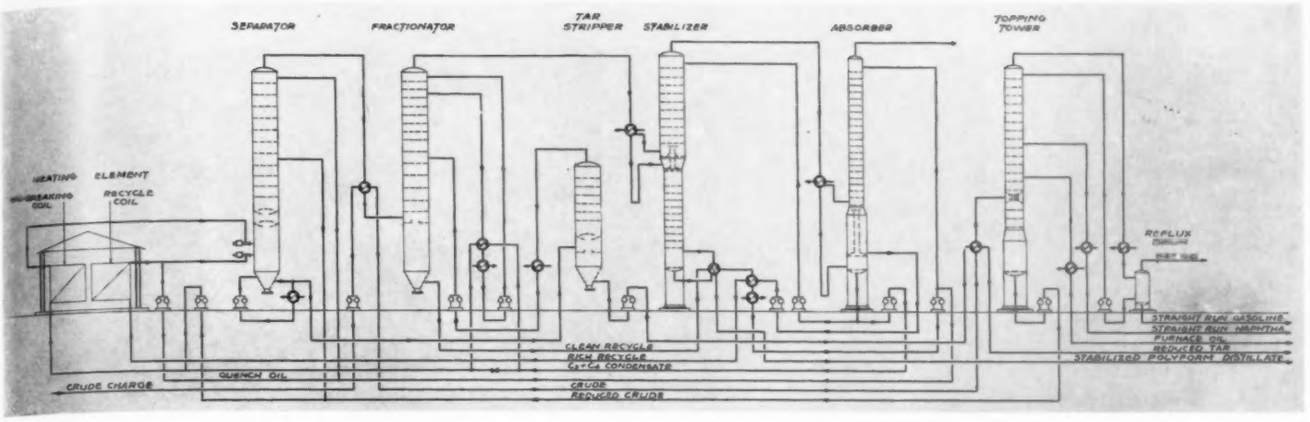


Figure 6: Two coil combination crude polyform unit.

TABLE NO. 6

Comparison of C. F. R.-A. S. T. M., C. F. R.-Research and C. F. R.-Uniontown 1937 Road Octane Numbers of Polyform Gasolines and Straight Run Gasoline Blends.

Description of Gasoline	Octane Number C. F. R. A. S. T. M.	C. F. R. Research	Research Minus A.S.T.M.	C. F. R.—Uniontown—1937 Road Octane Number Chevrolet	Ford	Plymouth	Avg.	Road Minus ASTM
Naphtha Polyform	75.1	85.0	+ 9.9	79.7	79.1	78.8	79.2	+ 4.1
Naphtha Polyform with Outside Gases	76.1	87.2	+11.1	82.3				+ 6.3
Mixture-48 percent Pa. St. Run+52 percent Naph. Poly.	70.0	74.5	+ 4.5				72.0	+ 2.0
West Texas Polyform	73.6	84.2	+10.6	77.0	77.3	77.2	77.2	+ 3.6
Mixture of West Texas St. Run and West Texas Polyform	70.8	73.6	+ 3.1	75.0	74.3	74.8	74.7	+ 4.2

hydrocarbons in the same coil it will be seen from Figure 1 that this will call for higher cycle ratios for the C_3 and C_4 hydrocarbons than if these gases are cracked in the presence of straight run naphtha.

For instance, a light recycle stock like the oil represented by Curve D on Figure 1 can only be cracked to a conversion per pass of approximately 45 percent in C_3 and C_4 dilution without running into coking troubles.

Cracking this oil to 45 percent crack-per-pass at 1020 deg. F. at 1000 lbs. per sq. in. will call for a soaking time of 60 seconds. At the same time the butane will be subjected to a conversion per pass of 10 percent and the propane to a conversion per pass of four percent, calling for cycle ratios between butane charged through the heating element and fresh butane introduced to or formed in the system of 10:1 and the corresponding cycle ratio for the propane of 25:1. These ratios may seem high, but are counter-balanced by the fact that heavier oils, when cracked, produce smaller percentages of total gas and hence also of C_3 and C_4 hydrocarbons than do naphthas, and the right recycle ratio of C_3 and C_4 hydrocarbons to oil furnace feed is usually obtained when the proper dilution for increased crack per pass is maintained.

From the foregoing it may be concluded that an upper limit for the amount of C_3 and C_4 hydrocarbons which should be cycled through the heating coil with a certain oil when it is desired to crack completely and polymerize the C_3 and C_4 hydrocarbons can be exactly determined when the cracking characteristics of the oil are known and the amounts of C_3 and C_4 hydrocarbons charged to the system, or formed in the system, are known.

If there is introduced to the system not only an oil feed, but also a certain amount of C_3 and C_4 hydrocarbons from the outside and the conversion characteristics of the oil are known, it is easy to compute the cycle ratio which must be maintained for converting completely the C_3 and C_4 hydrocarbons introduced to the system from an outside source.

Generally speaking, the gasoline produced per pass for oils above heavy naphtha boil-

TABLE NO. 5

Yields and Products from Polyform Operation on Crude Oils

Charge Running for	Heavy Venezuela Crude Heavy Fuel Oil	West Texas Crude Light Fuel Oil	West Texas Crude Bunker C Fuel Oil
Thruput, B/Stream Day	5,000	5,000	22,000
Type Unit	Polyform	Polyform	Polyform
Polyform Coils:			
Reduced Crude	1	1	1
Recycle	1	1	1
Virgin Gas Oil	..	..	1
Naphtha	..	..	1
Yield Data: Volume percent of Crude			
Gas, F. O. E.	4.9	3.9	11.5
Straight Run Gasoline	8.8	29.6	13.1
Furnace Oil	2.2	4.2	0.6
Stabilized Polyformed Dist.	32.7	29.8	50.4
Fuel Oil	54.6	32.0	27.4
Total	103.2	99.5	103.0
Gas: CF/B Crude	239	192	420
: CF/B Polyformed Dist.	733	644	835
Laboratory Inspections Crude			
Gravity: deg. A. P. I.	17.9	34.2	34.4
Viscosity, SUV at 100 deg. F.	1026	45	43
Sulfur, B: percent	1.92	1.50	1.57
Water and Sediment: percent	0.5	0.1	0.2
Distillation			
Over Point: deg. F.	198	124	130
Percent at 392 deg. F.	8	31	30
Percent at 700 deg. F.	65	76	
10 percent at: deg. F	431	240	235
50	682	554	560
Stabilized Polyform List			
Gravity: deg. API	55.5	58.0	56.7
Sulfur, L: percent	0.39	0.44	0.24
Acid Heat: deg. F.	112	114	121
Aniline Point: deg. F.	88	88	....
Octane No., CFR-ASTM	74.9	74.8	73.3
Vapor Pressure, 100 deg. F. :PSI	11.2	9.5	9.6
Distillation			
Over Point: deg. F.	82	88	95
End Point: deg. F.	422	422	418
10 percent at: deg. F.	132	127	136
50	269	253	242
90	392	382	372
Fuel Oil			
Gravity: deg. API	5.1	12.0	7.1
Viscosity, Furol at 122 deg. F.	1546	84	215
Sulfur, B: percent	2.9	2.0	2.06
Water and Sediment: percent	0.1	0.2	0.5
Pour: deg. F.	55	20	35
Residue Gas			
Sp. Gr. (Air = 1.0)	0.819	0.837	0.838
Podbielniak Analysis			
Methane and Hydrogen: Mol. percent	35.9	54.2	51.4
Ethane and Ethylene	32.8	33.4	34.3
Propane and Propylene	10.2	11.3	13.0
Butenes and heavier	1.1	1.1	1.3
Total Unsaturates	6.4	5.6	5.4

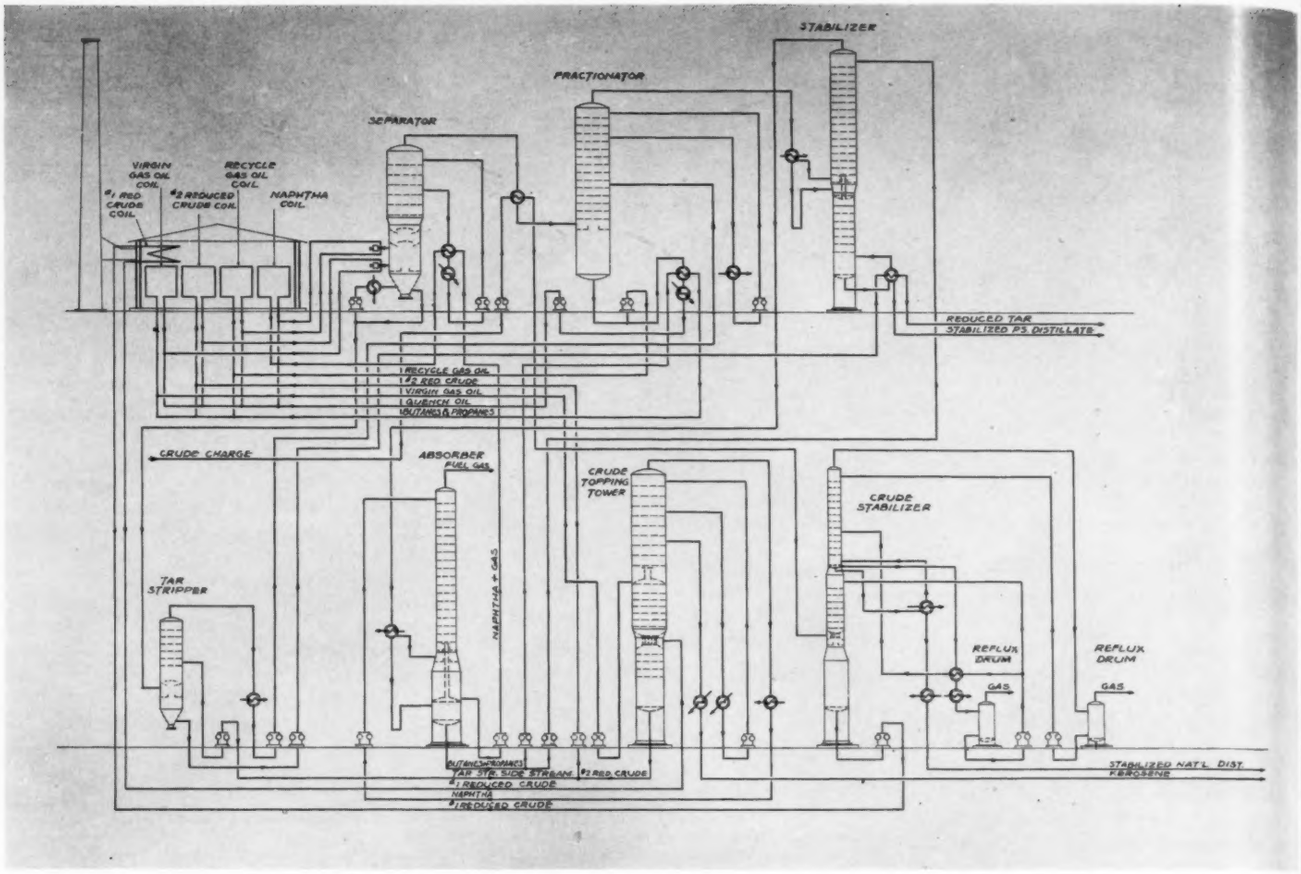


Figure 7: Four coil combination crude polyform unit.

TABLE NO. 7

Blending Value of 76.5 C. F. R.-A. S. T. M. Octane No. Polyform Distillate in A5 Reference Fuel

Blend No.	1	2	3	4	5
Percent Polyform Distillate in Blend	5	15	25	50	75
Percent A5 Reference Fuel in Blend	95	85	75	50	25
CFR-ASTM Octane No. of Blend	43.5	48.1	52.6	62.1	70.0
Calculated CFR-ASTM Octane No. Blending Value of Polyform Distillate	102.0	92.0	89.2	83.8	79.8

Blending Value of 76.5 C. F. R.-A. S. T. M. Octane No. Polyform Distillate in 5 1-5 deg. A. P. I. Mid-Continent Naphtha

Blend No.	1	2	3	4	5	6
Percent Polyform Distillate in Blend	5	10	20	30	40	50
Percent 51.5 deg. API M.C. Naphtha in Blend	95	90	80	70	60	50
CFR-ASTM Octane No. of Blend	39.7	42.3	48.9	52.0	56.9	61.9
Calculated CFR-ASTM Octane No. Blending Value of Polyform Distillate	110	109	100	89	88	87

ing range may be increased from 1.5 to two times the crack-per-pass obtained in an ordinary thermal cracking unit by employing the polyform principle.

The figures in Table 1 show a comparison between conversion per pass with ordinary thermal cracking and with the polyform process.

POLYFORM UNITS

To illustrate the flexibility of the polyform process, the following descriptions of different types of polyform units now in service are given with simplified flow diagram and typical yields. Figure 2 shows the simplest type of a once-through polyform unit. This type of unit is particularly adapted for polyforming of naphthas, kerosene, and light furnace oil, with simultaneous polymerization of C_3 and C_4 hydrocarbons from other cracking units. The unit consists of the same elements present in any ordinary type of cracking unit, such as heater, separating and fractionating tower, stabilizer, and absorber.

The cold naphtha charge is used for absorption oil in the absorber, which is equipped with sidestream coolers for removal of heat of absorption for full control of absorption, and to give desired gas circulation. The rich oil from the absorber constitutes the furnace charge. A second absorber, not shown on flow sheet, may be added using light gas oil reflux for absorption oil to extract the C_3 and C_4 hydrocarbons from outside gases charged to the unit. The second absorber is only necessary when outside gas feed contains large percentages of hydrocarbons lighter than propane, and it is not desired to boost the outside gases to the pressure in the naphtha absorber, as the gas oil absorber may be operated at lower pressures. Ordinarily outside gases can be discharged directly into the naphtha absorber if in liquid phase or into vapor line between stabilizer and pre-condenser if in vapor phase.

Recirculated bottoms from the combined separating and fractionating tower are used for quench oil to the tube outlet ahead of the reducing valve in order to avoid coke formation in the transfer line and separating tower. The excess heat in the tar quench oil is usually sufficient for satisfactory reboiling of the polyform distillate in the stabilizer. The combined naphtha and absorbed gas furnace charge is preheated to approximately 500 deg. F. to 550 deg. F. in trap tray and gas oil sidestream high pressure heat exchangers before entering the furnace. The furnace is usually designed with two chambers, one bringing up section and one soaking section, to permit full control of polyform reactions.

Typical operating conditions for this type of unit are:

Back pressure on heating element—
1000-1500 lbs./sq. in.
Tower pressure ..... **300- 400 lbs./sq. in.**
Outlet temperature from heater
1020–1125 deg. F.

Table 2 shows yields and inspections of the charge and products from naphtha polyform-

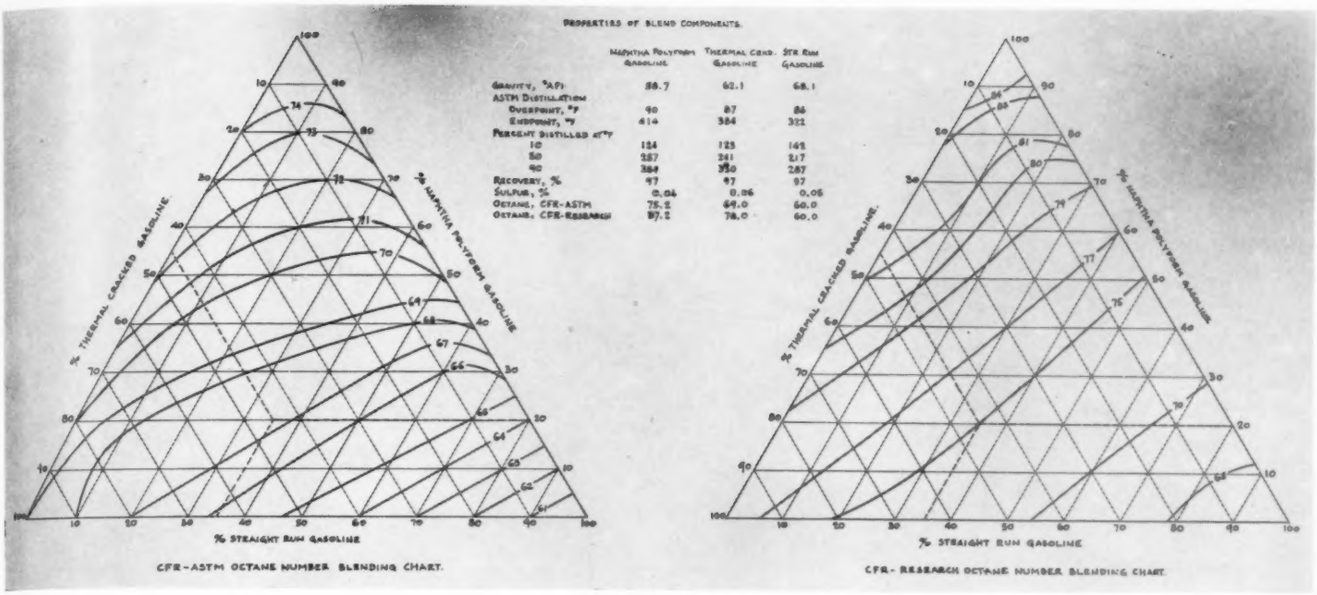

PROPERTIES OF BLEND COMPONENTS
% THERMAL CRACKED GASOLINE
% NAPHTHA POLYFORM GASOLINE
% STRAIGHT RUN GASOLINE
CFR-ASTM OCTANE NUMBER BLENDING CHART.
CFR-RESEARCH OCTANE NUMBER BLENDING CHART.

Figure 8: Blending charts for straight run gasoline and thermal cracked gasoline from gas oil cracking with naphtha polyform gasoline.

ing without outside gas charge of (1) Eastern Venezuela naphtha 10 percent of crude, (2) West Texas straight run gasoline 25 percent of crude, and (3) a 50-50 mixture of Pennsylvania and Mid-Continent naphthas. In this table are also given the yields and inspection of the charge and products from two naphtha polyform units installed at the Gulf Oil Corporation's Pittsburgh and Cincinnati plants, charging, in addition to Mid-Continent naphtha, all of the gases from the balance of the refinery. These units are equipped with gas oil absorbers operating at approximately 225 lbs. per sq. in. pressure for the absorption of C_3 and C_4 hydrocarbons from the refinery gases. The gas oil is a side-stream reflux from the fractionating tower and the rich gas oil is refluxed back to the fractionating tower, in this manner introducing the C_3 and C_4 hydrocarbons in the outside gas to the units.

Figures 3 and 5 give complete yield-octane relationship from polyforming the Eastern Venezuela naphtha and the West Texas straight run gasoline for which inspections are given in Table 2. Curves showing T. E. L. response with 1 cc. and 3 cc. of T. E. L. per gallon of polyform distillate are indicated on these plots.

Figure 4 contains plots showing volume percent yield of blends, clear plus 1 cc. T. E. L. per gallon, and plus 3 cc. T. E. L. per gallon of clay treated naphtha polyform distillate and straight run Venezuela gasolines at various degrees of polyforming the naphthas. The yields are indicated in percent of the 28.5 percent on the crude straight run Eastern Venezuela gasoline with properties as shown in Table 3. This gasoline was reduced by removing 5 percent, 10 percent and 15 percent on crude of naphtha cuts with properties as shown in Table 3, which also shows inspections on the 23.5 percent, 18.5 percent and 13.5 percent on crude of light gasoline cuts remaining after removal of the naphtha cuts. The naphtha cuts were polyformed to different octanes and blends prepared from the various naphtha polyform distillates with corresponding straight run gasolines. Figure 4 is very useful in working up economic balances to determine the most economical percentage of naphtha to polyform; it also shows clearly the large T. E. L. saving which may be obtained by the polyform process at the expense of small reductions in total yield of gasoline.

There are at present three units of this type in service, which, besides polyforming naphtha, polymerize all residue gases from the balance of the refinery. Two units are under construction.

Two of the existing units are equipped with coking drums, into which the reflux from the furnaces is discharged. The stock to be coked, reduced crude or pressure still tar from other units, is introduced as quench oil to the transfer line at the furnace outlet. The tar is coked by means of waste heat in the furnace discharge. Reduced crude or tar of any gravity can be coked in this manner, or any heavy slop oil from the refinery can be converted to gasoline, coke, and clean pressure still charging stock.

Typical yields from polyform coking different heavy charging stocks are shown in Table 4. The operations indicated in Table 4 were conducted to produce, in addition to gasoline and coke from the heavy stocks, a pressure still charging stock of approximately 750 deg. F. end point suitable for cracking in ordinary thermal gas oil cracking units. This type of coking is very cheap as the only added operating expense is the cost of cleaning coke drums, and the overhead charges on coke drum installation. There are distinct advantages in coking a tar, low in hydrogen, in gas dilution, because of the low percentage of coke produced from polyform coking.

TABLE NO. 8

Properties of Clay Treated and Acid Treated Polyform Gasolines

Polyform Gasoline From	M. C. NAPHTHA		WEST TEXAS CRUDE					
	Raw Distillate	Clay Treated	Raw Distillate	Caustic Washed, Acid Treated, Doctor Sweetened Distillate of Various End Points From Raw Distillate				
				300 E.P.	525 E.P.	350 E.P.	375 E.P.	400 E.P.
Yield: percent of charge	100	97	100	58.1	65.1	77.2	84.5	90.6
Gravity: deg. A. P. I.	58.4	59.8	56.7	68.1	65.3	61.3	60.3	57.9
Color: Saybolt		+30	+ 6	+30	+30	+30	+27	+25
: N. P. A.	1.0							
Doctor Test	Bad	Poor	Bad	Good	Good	Good	Good	Good
Sulfur: L percent	.05	.03	.24	.05	.07	.08	.09	.10
Cu. Dish Gum: Mg/100 CC	118	9						
Preformed Gum: Mg/100 CC	4	4	17	1	2	3	3	3
Oxygen Gum: Mg/100 CC				67	55	181	44	140
Oxy. Stab. Min/210 deg.F.	+45	+30	195	45	75	30	75	135
Acid Heat: deg. F.	120	98	121	146	142	132	134	116
Aniline Point: deg. F.	86	92						
Oct. No. C.F.R.-A.S.T.M. L-3	75.8 79.8	76.5 80.1	73.3	75.9 77.9	75.4 77.0	74.8 76.6	73.8 75.8	73.2 75.3
Reid V. P. at 100 deg. F. #/Sq. In.	10.9	11.4	9.6	12.9	11.7	10.9	10.1	9.8
Distillation:								
Over Point: deg. F.	88	82	95	94	96	98	100	100
End Point: deg. F.	416	415	418	302	326	348	375	395
10 percent at	122	119	136	118	124	130	136	139
50 percent at	226	224	242	184	196	216	230	240
90 percent at	374	372	372	260	282	308	334	351
Recovery: percent	96	96	97	96	96	97	97	97

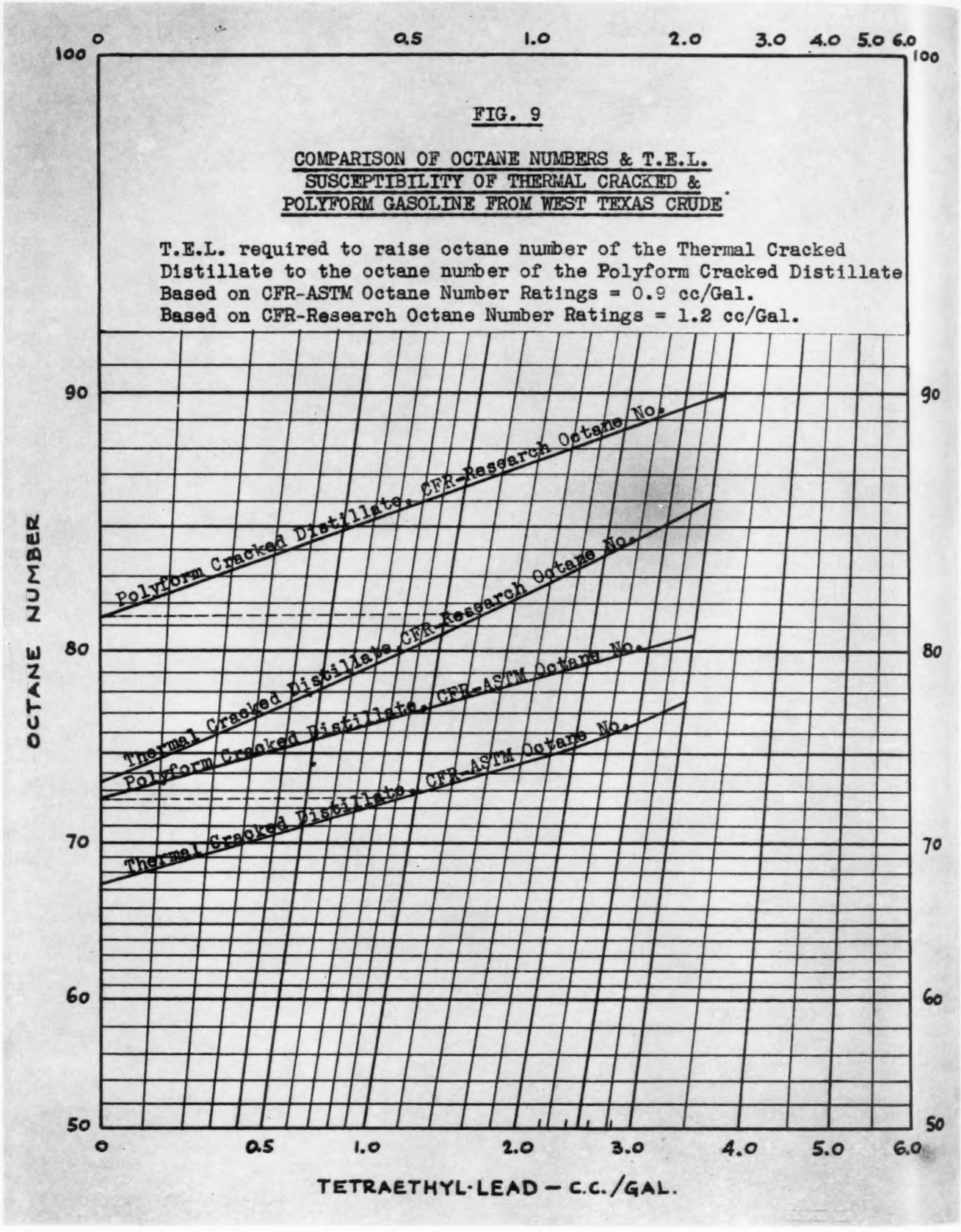


Figure 9.

TWO-COIL COMBINATION

A two-coil combination crude polyform unit flow is shown in Figure 6. In a unit of this type, when there is no straight run naphtha included in the charge, the next refractory stock, light recycle oil, is used for absorption oil in the absorber. The general flow, Figure 6, is as follows: crude is preheated in exchangers and flashed into a topping tower, from which

the desired straight run products are removed. The hot reduced crude is charged direct to the vis-breaker furnace together with a heavy recycle sidestream from the separator. C_3 and C_4 condensate from condensation of stabilizer overhead is pumped through high pressure exchangers into the vis-breaker furnace charge. The clean recycle stock from the base of the fractionating tower reboils the polyformed distillate in the stabilizer, preheats the rich recycle furnace charge, and is then cooled and pumped to the top of the absorber as absorption oil. The rich light recycle stream is pumped from the base of the absorber through high pressure heat exchangers to the recycle polyform coil.

In a unit of this type very little cracking and polymerization of gases takes place in the vis-breaker coil. Practically all gas cracking and polymerization occurs in the recycle coil. Typical operating pressures and temperatures applied in polyform vis-breaking heavy reduced crudes are listed below:

Back pressure of vis-breaker coil	400-600 lbs./sq. in.
Back pressure of recycle coil	1000-1200 lbs./sq. in.
Tower pressure	300- 400 lbs./sq. in.
Outlet temp. of vis-breaker coil	900- 930 deg. F.
Outlet temp. of recycle coil	1000-1010 deg. F.

By adding coke drums between the vis-breaker furnace and the separating tower the vis-breaker charge may be once-through coked with a marked increase in polyformed gasoline yield. Table 5 shows yields from polyform vis-breaking of 17.9 deg. A. P. I. Venezuela crude and polyform vis-breaking of 34.3 deg. A. P. I. gravity West Texas crude.

FOUR-COIL COMBINATION

Figure 7 is a simplified flow sheet of a 22,000 bbl. per day crude topping and polyform unit at the Gulf Oil Corporation's Port Arthur plant. The only products from this unit are stabilized straight run gasoline, stabilized polyformed distillate, Bunker C fuel oil and dry gas of .78 to .84 specific gravity. In one unit it replaces the conventional type of combination units, thermal or catalytic polymerization unit, gas compression and absorption plant, crude and pressure still distillate stabilization plants.

The general flow is as follows: crude is charged through heat exchangers into the high pressure crude flash-tower from the top of which unstabilized straight run gasoline is removed. The straight run gasoline is stabilized in the stabilizer section of the crude flash tower and from here is passed to running tanks. The No. 1 reduced crude is pumped through a crude heating coil into the atmospheric tower from the top of which a straight run naphtha cut is removed, condensed, and pumped as absorption medium to the top of the absorber. From the atmospheric topping tower a furnace oil or kerosene sidestream can be removed, if required. Below the furnace oil drawoff a virgin gas oil cut is removed. This virgin gas oil cut of 1.0-1.5 NPA color and approximately 700 deg. F. end point is charged hot to the virgin gas oil polyform coil with its allocated C_3 and C_4 dilutent. In this coil the gas oil is polyformed once-through to between 35-45 deg. gasoline production per pass.

From the bottom of the atmospheric tower the No. 2 heavy reduced crude is charged hot through the polyform vis-breaker coil together with the heavy tar stripper sidestream and required C_3 and C_4 diluent. A conversion per pass of approximately 14 percent to 16 percent is obtained in this coil. The light recycle stock from the base of the fractionating tower of approximately 1.5 NPA color and 700 end point is likewise charged hot to the recycle polyform coil with the proper C_3 and C_4 dilution. The light recycle stock is subjected to a conversion per pass (gasoline produced) of approximately 25 percent to 32 percent. The C_3 and C_4 diluent for these three coils is all furnished as condensate from stabilizer overhead and is composed of approximately 25 percent butanes and 75 percent propanes. Rich naphtha from the base of the absorber is polyformed in the naphtha polyform coil. Both the C_3 and C_4 condensate diluent and the rich naphtha are preheated in high pressure heat exchangers to between 550 deg. F. to 620 deg. F. before being charged to cracking coils. All four coils discharge into one common separating tower, where the tar is reduced to 10 deg. to 12 deg. A. P. I. gravity without any difficulty. The tar is later reduced with steam in the atmospheric tar stripper to any desired gravity, such as two degrees A. P. I.

The type of pyrolytic conversion in this unit is truly selective. All virgin stocks are once-through polyformed before entering the tower system. For this reason the recycle stock is a real recycle oil, highly refractory, with aniline point of 30 to 35,as compared with 150 for virgin gas oil and 75 to 80 aniline point for recycle stock from thermal cracking units. Typical operating pressures and temperatures for this unit are as follows:

Back pressure on naphtha coil	1000-1200 lbs./sq. in.
Back pressure on recycle coil	1000-1200 lbs./sq. in.
Back pressure on virgin gas oil coil	500- 600 lbs./sq. in.
Back pressure on red. crude oil	500- 600 lbs./sq. in.
Tower pressures	350-400 lbs./sq. in.
Outlet temperature of naphtha coil	1060-1070 deg. F.
Outlet temperature of recycle coil	1000-1010 deg. F.
Outlet temperature of virg. gas oil coil	995-1000 deg. F.
Outlet temperature of red. crude coil	915- 930 deg. F.

Typical yields when charging a 34.4 deg. A. P. I. West Texas crude are shown in Table 5. Figure 9 shows a comparison of octane numbers and T. E. L. susceptibility of polyformed and thermal cracked gasolines from West Texas crude.

The octane number of polyform gasoline depends, like the octane number of all other cracked gasolines, to some extent on the characteristics of the charging stocks.[8] In

TABLE NO. 9

Properties of Aviation Gasoline and Safety Fuel from Polyform Gasoline

Yield Data	Naphtha	Polyformed Distillate	Finished Products Aviation Gasoline	Finished Products Safety Fuel
Volume percent Polyformed Distillate		100.0	39.2	35.3
Inspection				
Gravity: deg. API	47.5	49.8	55.8	36.2
Sulfur, Lipegeent	0.05	0.04	0.011	0.018
Freezing Point: deg. F.				Bel.-76
Copper Dish Gum: Mg/100 cc		187	1	
Oxygen Stability, 212 deg. F.: Minutes		105	300+	
Oxygen Gum: Mg/100 cc		219	1	
Acid Heat: deg. F.	2	68	10	2
Aromatic Content: percent:				
Benzene		4.4		
Toluene		10.7		
Xylene		11.6		
Total		26.7		
Aniline Point: deg. F.	136	37.1		
Octane No.: CFR-ASTM	47	82	77	80
+1 cc TEL/Gal.	57	86	84	86
2		88	88	87
3	66	90	90	88
Vapor Pressure, 100 deg. F.: PSI		10.0	6.2	
Distillation, ASTM:				
Over Point: deg. R.	266	86	114	301
End Point: deg. F.	431	448	307	426
10 percent at deg. F.	290	139	156	311
20 percent at	296		170	314
50 percent at	311	245	205	326
90 percent at	372	362	250	372

Inspection of Cuts from Fractional Distillation of Polyform Distillate

Cut. No.	1	2	3	4	Bottoms	Loss
Yield: percent by Volume	20.5	20.5	20.4	18.9	16.0	3.7
Gravity: deg. API	78.5	54.7	44.4	38.8	30.2	
Aromatic Contents: Percent						
Benzene	3.2	11.8	7.0			
Toluene	2.0	10.5	24.8	8.7		
Xylene		3.8	14.5	34.8	1.9	
Total	5.2	26.1	46.3	43.5	1.9	
Aniline Point: deg. F.		51	26.3	11.3		
Distillation, ASTM						
Over Point: deg. F.	71	132	196	248	324	
End Point: deg. F.	263	312	328	364	436	
10 percent at: deg. F.	77	157	212	265	336	
50	117	182	233	285	355	
90	188	227	272	322	396	

general the highest C. F. R.-A. S. T. M. octane number can be obtained from a naphthenic charging stock of low sulfur content and the lowest octane number from a paraffinic stock, and from high sulfur stocks. However, in naphtha polyforming, it is always possible to produce a gasoline with an octane number, C. F. R.-A. S. T. M., of 75 to 77, regardless of the characteristics of the charging stock.

OCTANE NUMBER

This is illustrated in Table 2, which gives the yields and inspections on charge and products from three different types of naphtha charging stocks of different boiling ranges, sulfur content, and octane numbers. It should be noted that the C. F. R.-A. S. T. M. octane numbers of the polyform distillate from the three charging stocks are very close, varying between 75.1 for the distillate from Mid-Continent-Pennsylvania naphtha mixture, and 76.1 from the Eastern Venezuela naphtha, while the Research octane number of the Mid-Continent-Pennsylvania distillate is the highest, 87 against 86.4 for the distillate from the Eastern Venezuela naphtha. This can be explained when comparing the C. F. R.-Research octanes with the yields from the various stocks. The yield of 83.9 percent from the Eastern Venezuela naphtha is the highest, while the yield from the Mid-Continent-Pennsylvania naphtha of 77.2 percent is the lowest, indicating a more severe conversion of the Mid-Continent-Pennsylvania naphtha.

Polyform gasoline is characterized by having a very much higher appreciation between C. F. R.-A. S. T. M. octane ratings and C. F. R.-Research octane ratings than ordinary thermal cracked gasoline. The spread between the A. S. T. M. and Research octane numbers of an ordinary thermal cracked gasoline is of the order of five to nine, while the spread for a polyformed gasoline is of the order of nine to fourteen.

The appreciation of road octane number above the C. F. R.-A. S. T. M. octane number is better for the polyform gasoline than for an ordinary thermal cracked gasoline from the same stock.

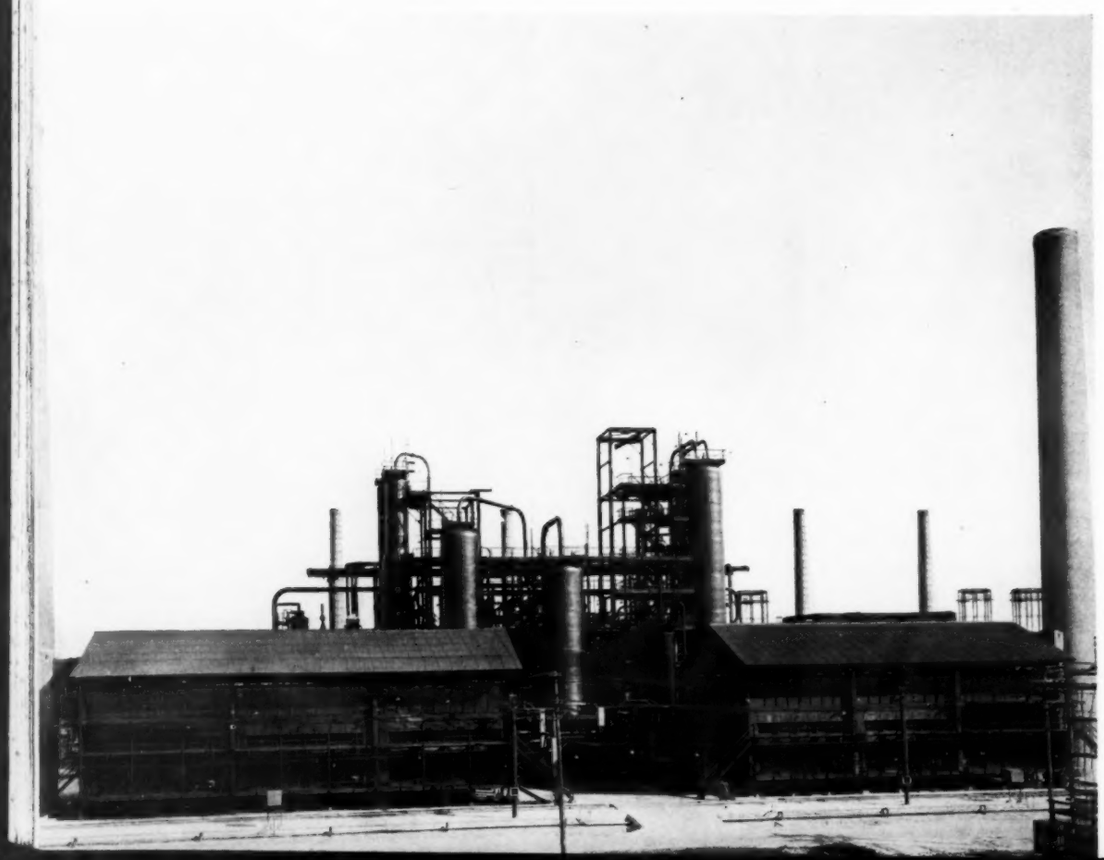
Table 6 shows a comparison between C. F. R.-A. S. T. M., C. F. R.-Research, and C. F. R.-Uniontown 1937 Road octane numbers of various polyformed gasolines and blends of these gasolines with straight run gasolines.

BLENDING VALUE

Polyform gasolines have excellent blending values in blends of straight run gasolines and naphthas, as indicated in Table 7. The blending value of polyform gasoline with thermal cracked gasoline of 68-70 octane number, C. F. R.-A. S. T. M. is practically the same as the clear octane number; the octane number of the blend being close to the arithmetic mean of the octane number of the components.

Figure 8 presents two three-coordinate blending charts, with C. F. R.-A. S. T. M. and C. F. R.-Research octane numbers, for blends of (1) straight run gasoline, (2) thermal cracked gasoline from gas oil cracking, and (3) naphtha polyformed gasoline, all stocks of Mid-Continent origin. The inspections ofthese stocks follow:

	Straight Run Gasoline	Thermal Cracked Gasoline	Naphtha Polyform Gasoline
Gravity—deg. A. P. I.	68.1	62.1	61.1
A. S. T. M. Distillation			
Over Point: deg. F.	86	87	86
End Point: deg. F.	322	384	402
10 percent: deg. F.	142	125	130
50 percent at: deg. F.	217	241	244
90 percent: deg. F.	287	350	352
Recovery:percent	97.0	97.0	97.0
Acid Heat: deg. F.	6	172	151
Percent sulfur	0.05	0.06	0.05
Octane No.:			
CFR-ASTM	60	69	75.2
CFR-Research	60	78	87.2



To illustrate the use of these charts, lines are indicated for a blend of 35 percent straight run gasoline, 45 percent thermal cracked gasoline, and 20 percent naphtha polyformed gasoline, showing 67.2 C. F. R.-A. S. T. M. octane number on the one chart and 75 C. F. R.-Research octane number on the other. These charts show the high blending value of a polyformed distillate in the run-of-plant gasoline from a northern refinery.

LEAD SUSCEPTIBILITY

The lead susceptibility of polyform gasolines for the same starting octane number compares very closely to thermal cracked gasolines and is influenced similarly by sulfur content. Figures 3 and 5—yield-octane relationship from Eastern Venezuela naphtha and West Texas straight run gasoline polyforming, show the lead susceptibility of these gasolines. Figure 9 shows a comparison of lead susceptibility of polyform and thermal cracked gasolines from West Texas crude. From this plot it should be noted that it takes 1.2 cc./gal. of T. E. L., corresponding to approximately 13 cents per bbl. of gasoline to lead the ordinary thermal cracked gasoline to the same C. F. R.-Research octane number as the polyformed distillate.

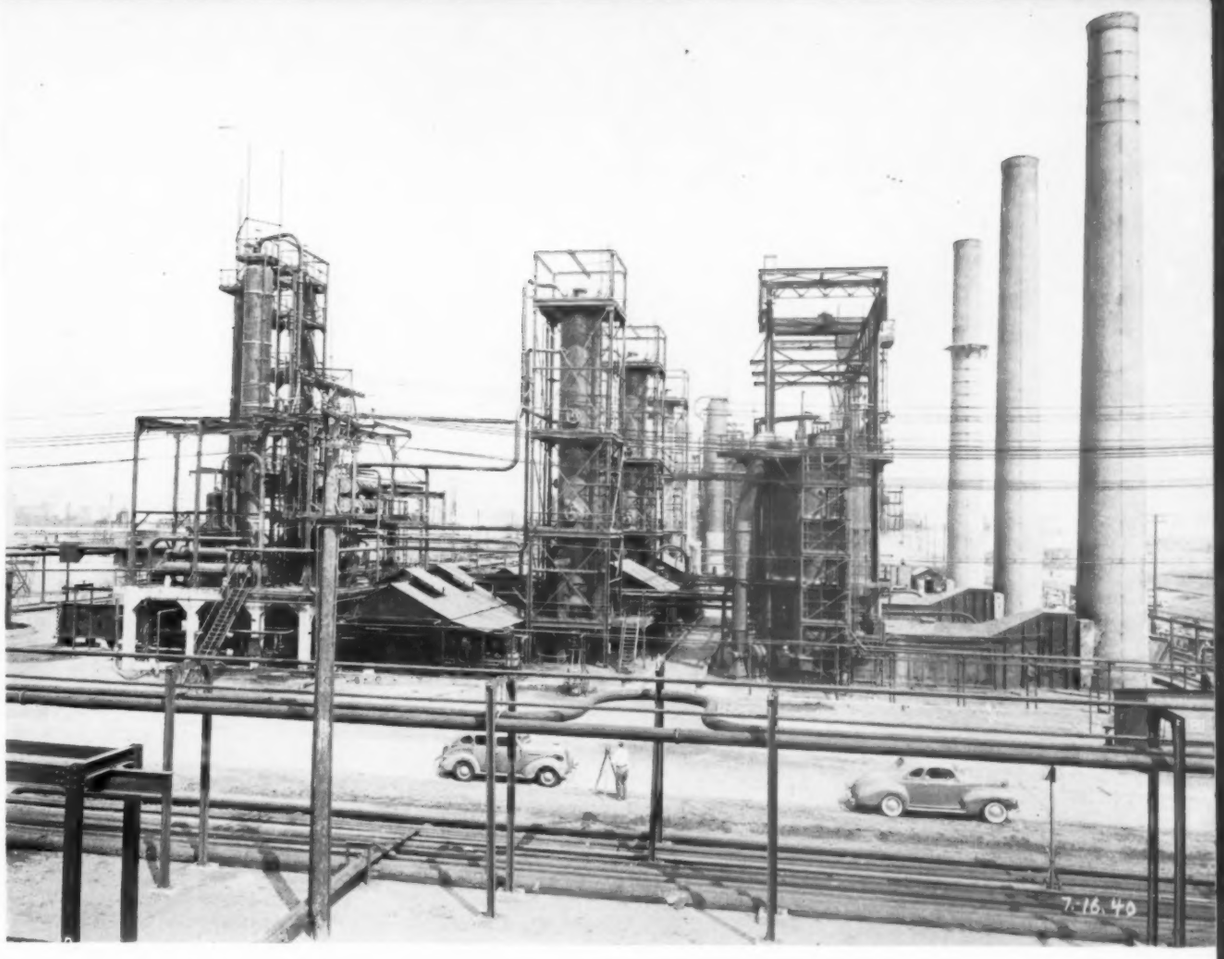
TREATING

The treating of polyform distillates does not differ from the treating of conventional thermal cracked distillates and presents no added problems. Polyform gasoline made from sweet naphtha or crude may be cut directly off the unit and blended into a final colored gasoline after the addition of gum inhibitor. For use in water white gasoline blends, polyform distillate from sweet naphtha or crude may be clay treated with a production of 3,000 to 5,000 bbl. per ton of clay and resulting in a distillate of plus 30 color, an increase in C. F. R.-A. S. T. M. octane of 0.5 to 0.75 point, a decrease in acid heat, and an increase in gum inhibitor response. Table 8 shows the inspections before and after clay treating polyformed Mid-Continent naphtha distillate.

Polyform distillate of over 0.1 percent sulfur from a sour naphtha or crude may be cold acid treated with two to five pounds per barrel of acid for reduction of sulfur to specifications followed by rerunning to end point, sweetening, and gum inhibiting. The octane number drops from 0.0 to 0.5 C. F. R.-A. S. T. M., depending upon the original sulfur content and the extent of sulfur reduction. Table 8 shows the inspections on raw West Texas polyformed distillate and inspections on different gasolines with end point from 300 deg. F. to 400 deg. F. produced from the raw distillate by acid treating, rerunning, and sweetening.

Polyform gasoline may be sweetened by any accepted sweetening method, such as doctor sweetening, lead sulphide sweetening, etc.

With modified operating conditions a polyform unit can be adjusted to produce a distillate with an octane number C. F. R.-



Opposite, a 22,000 bbl. per day West Texas crude four-coil combination polyform unit in the Port Arthur refinery of the Gulf Oil Corporation. Right, a two-coil combination crude polyform unit in Gulf's Girard Point plant.

A. S. T. M. of from 80 to 84. A distillate of this type may be produced from any type of stock, but preferred stocks are gasolines, naphthas, kerosene and light furnace oils.

AVIATION GASOLINE

The 80-84 octane polyform distillate is highly aromatic and can be acid treated to produce a satisfactory aviation gasoline of approximately 77-79 C. F. R.-A. S. T. M. octane number which can be leaded to 90 C. F. R.-A. S. T. M. octane number with less than 3 cc. of T. E. L. per gallon, and an 80 C. F. R.-A. S. T. M. octane number aviation safety fuel with boiling range between 300 deg. F. and 425 deg. F.

To produce these aviation fuels the polyformed distillate is first separated into a light and a heavy cut by rerunning. The light cut is cold acid treated with 20 lbs. of 98 percent acid and rerun to aviation gasoline boiling range. The heavy cut is treated with five pounds of 98 percent acid and rerun to safety fuel specifications.

Table 9 gives the inspections of the original charge naphtha, the 82 C. F. R.-A. S. T. M. octane number polyformed distillate produced from this naphtha, and the finished aviation gasoline and safety fuel produced from the polyformed distillate.

The foregoing operation may be carried out with a somewhat modified flow arrangement to yield an increased amount of aviation gasoline without the simultaneous production of safety fuel.

It will be noted from Table 9 that the aromatic content of the 82 octane polyformed distillate, particularly toluenes and xylenes, is high and that these fractions may be readily concentrated by distillation.

SUMMARY

A new refining process, the Gulf Polyform Process, is presented in this paper. This process combines in one operation the pyrolytic processing of oils to higher conversion per pass than is possible in an ordinary thermal unit with polymerization of refinery gases produced either from the oil undergoing conversion or from an outside source. Flow sheets and photographs of naphtha polyform, 2-coil crude polyform, and 4-coil crude polyform units are presented and discussed. The process produces high yields of high octane gasoline possessing excellent distillation, lead susceptibility, blending, and Research or Road octane appreciation characteristics from any type of charging stocks. Properties and treating of polyform distillates were presented. Specification aviation gasoline which will lead to 90 C. F. R.-A. S. T. M. octane number with less than 3 cc. T. E. L., and 80 octane number C. F. R.-A. S. T. M. unleaded safety fuel can be made from polyform distillate.

Under the patents of the Gulf Oil Corporation and the Phillips Petroleum Company, The Lummus Company now offers the Polyform or Gas Reversion Process to the refining industry. The process has been in commercial operation for over four years with five units in Gulf Oil Corporation refineries, ranging from 1,500 bbl. per day to 22,000 bbl. per day charge capacity. The Lummus Company is at present building two large naphtha polyform units with a total production of 14,000 bbl. per day of 76 C. F. R.-A. S. T. M. octane number gasoline. The process, with investment costs and operating costs comparable to thermal cracking units, and operating problems no more difficult, establishes itself as a practical economical process for the production of high yields of 75-82 C. F. R.-A. S. T. M. octane number gasoline from any type of naphtha charge and 72-74 C. F. R. A. S. T. M. octane number gasoline from any full crude, as well as means of converting economically outside propanes and butanes along with naphtha into high yields of 76-82 C. F. R.-A. S. T. M. octane number gasoline.

A more complete paper covering the Gas Reversion and Polyform Processes as practiced by The Phillips Petroleum Company and the Gulf Oil Corporation will be presented at a later date jointly by these companies and The Lummus Company.

ACKNOWLEDGMENT

The authors wish to take this occasion to express their appreciation to the operating personnel, laboratories and technical staff of the Gulf Oil Corporation for the inspection, analytical and operating data recorded in this paper.

OILFIELD MOVIE Achieves Authentic Atmosphere

"Boom Town" with Distinguished Cast Presents Lively Story Against Plausible Petroleum Background.

AN ENTIRE oilfield of authentic appearance had to be designed and constructed for the filming of the recently released motion picture "Boom Town". When MGM undertook to film a story with a background of oilfields, refineries, gushers and burning wells, the director was faced with a set of unique technical problems.

The film depicts the rise of two wildcat operators from relative obscurity to international prominence. Throughout the entire story scenes are laid against a background of oil operations in the early years of the present century. As the producing, refining and marketing of petroleum products plays so prominent a part in the picture, every effort has been made to achieve an appearance of authenticity.

The picture was produced by Metro-Goldwyn-Mayer with a cast including Spencer Tracy, Clark Gable, Frank Morgan, Claudette Colbert and Hedy Lamarr. Technical details were under the personal supervision of Ford Alexander, who for 27 years has been an expert in shooting wells and blasting out oil well fires.

For one scene the construction department received an assignment to produce a synthetic gusher that would be genuine even to the shaking of the ground when the gusher would blow. The scene was erected in Lost Hills near Bakersfield, California. What appeared above the ground was a wooden structure, 80 ft. in height, in the best 1920 style, with a complete cable tool outfit.

Below the ground, however, the well was holeless. Into the casing had been fitted engineering equipment which would hurl crude oil 200 ft. into the air. High pressure pumps, operated by 300 h.p. motors, did the hurling when quick-action valves, controlled from a switchboard, were touched off. The oil itself was in a 300,000 gal. storage tank out of camera range, and a concrete sump hole caught the oil after each take and sent it back for re-use. With a pressure of 130 lbs. per sq. in., 15,000 gal. a minute went toward the sky.

Originally, a substitute was planned for oil, inasmuch as actual crude is untasty and difficult to remove from the skin and clothes. Only one thing was found to suffice, a mixture of molasses and water. Experimenters prepared such a bath for Gable and Tracy, but Bakersfield citizens protested. Although the well was seven miles from the nearest habitation and would damage no property, that much sweetness scattered upon barren ground would create a breeding place for flies for months to come. The protest being logical, the company was forced to use crude oil.

A well which, during the picture, comes in as a worthless geyser of salt water had to be staged under the same principles. However, the background had to be different from the gusher and a locale was selected 30 miles beyond Taft, California, in a spot so barren that a dust storm kept everyone choking throughout the filming. So far removed was it from any community that it actually cost more to film the water well than the oil gusher as the water had to be hauled in. The site was so isolated that when the derrick was set up birds descended upon it to build nests.

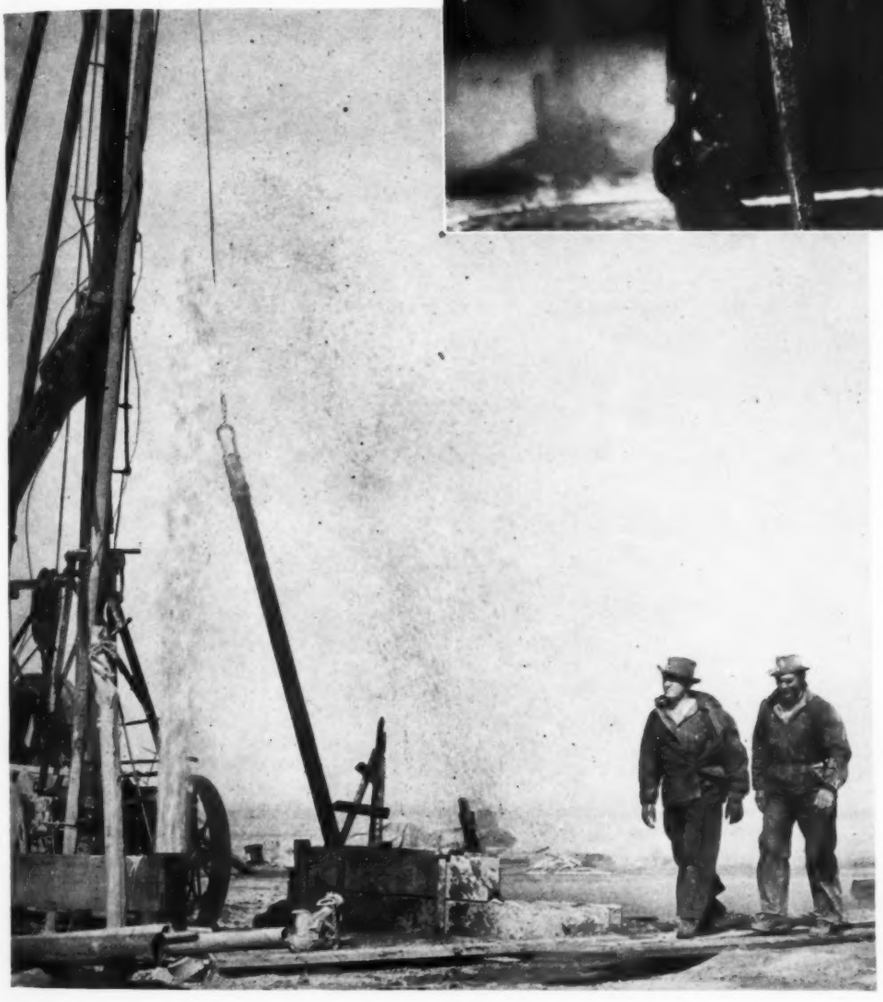
The construction staff staged a burning oil well scene on the studio's 60 acre location tract, again employing pressure pumps. The mixture shot forth, however, was a combination of crude oil, gasoline and natural gas and it blazed to a height of 300 ft. through the manipulations of an operator at a control panel which looked like a caliope keyboard. Two thousand gallons of gasoline, or enough to propel the average auto one and a half times around the world, went up in smoke every minute of that fire while seven cameras photographed it from various angles.

Clark Gable and Spencer Tracy, for the oil well fire scene, were swathed in layer after layer of burlap which was drenched with water from firehoses as they approached the fire to plant a charge of nitro-glycerin. This odd procedure was necessary because the time of the incident was 1921, before the advent of asbestos suits. The actual explosion of TNT which whiffed out the fire as a man blows out a candle was executed by Ford Alexander himself. In real life, Mr. Alexander has done that trick many times with water soaked

Left to right, Ford Alexander, oil well fire fighter and technical advisor on the picture "Boom Town"; Jack Conway, director; Spencer Tracy and Clark Gable shown on location in Lost Hills, near Bakersfield, California.

burlap and all. Today, of course, he employs the asbestos suit.

The modern method used today by Mr. Alexander is still an impressive sight. Actually, he walks right up to the pillar of fire, dressed in asbestos, approaching behind a metal screen to avoid flying rocks and debris. At the fire he sets up a seven foot highchair on which he deposits 150 lbs. of explosive in a metal container, wrapped in asbestos. He connects his insulated electrical wires and then retreats with all possible haste. The asbestos covering for the TNT is good for only three minutes and he must be 300



Oil well fire fighting in 1921; water soaked burlap was used instead of asbestos suits in placing the charge of explosive at the base of the fire: Left, Clark Gable and Spencer Tracy, stars of the oilfield movie, "Boom Town" bring in a salt water producer in their roles as West Texas wildcatters.

ft. away when the charge is set off. Incidentally, the asbestos suit is good for only one trip.

This was Mr. Alexander's first contact with motion pictures, but his advice is responsible for the genuine oilfield atmosphere throughout the film. He worked through mud, oil, fire, dust and excitement for 12 weeks, setting every oil scene for authenticity and in the end called it a "pleasant vacation," and rushed back to his job of giving oil fires the hot-foot.

A staggering amount of oilfield equipment was rented for this single picture. Five hundred tons of cable tools, such as drills, wrenches, valves, cables and casing were used in the sets. In addition to the 150 buildings and 50 derricks were the nine working wells used in the jungle setting representing oil operations in Central America. Scenes depicting Gable and Tracy working on the platform of a drilling well were taken in a real field.

Clark Gable of course had the advantage of his fellow members in the cast in that he has had actual oilfield experience, having once held a job as tool dresser, in what was then called Bigheart, Oklahoma, now known as Barnsdall. The monotony of tool dressing forced Gable into the refining branch of the oil business where he started as one of the labor gang. His work consisted of removing deposits of coke from the stills. The stills would be allowed to cool for 12 hours and then the men would go to work. Only one man could enter the small space at a time. There were eight men on a shift and each man worked two minutes and rested fourteen. It was as much time as they could endure within the stills. As Gable explained "if a fellow didn't come out at the end of two minutes someone went in and dragged him out."

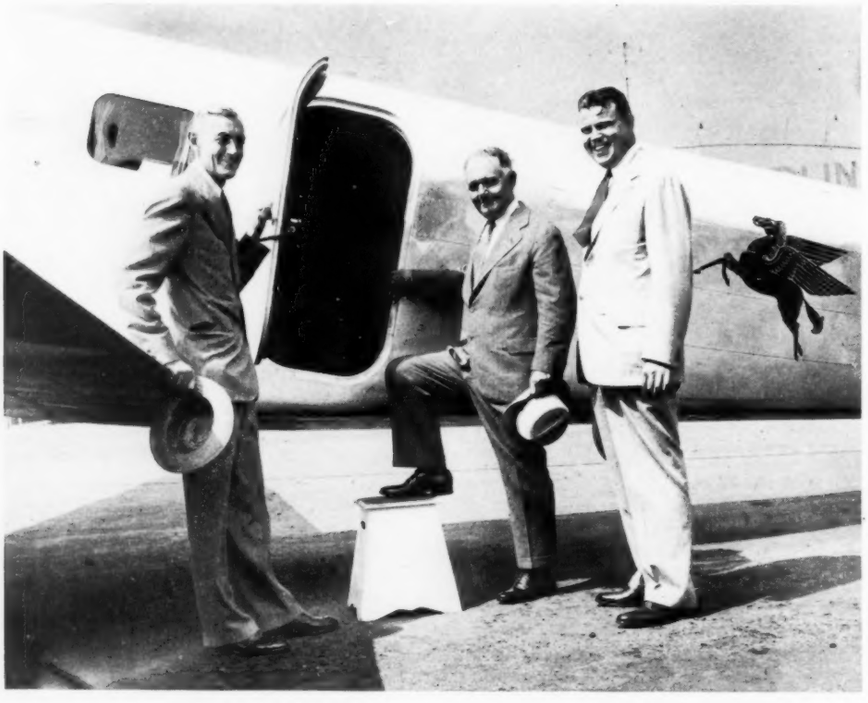
For shots in a refinery, the camera crew was taken to a real refinery, but were confronted there with unusual problems in face of the caution exercised by the refining company. No electrical machines of any kind were permitted within the plant and modern cameramen, working only with automatic and electrically-driven machines, had to practice grinding their cameras by hand for two days to perfect their timing and speed. All lighting was done with reflectors and it was necessary for the men, before shooting the scene, to empty their pockets of money and knives and don rubber overshoes. To prevent any possible sparks from the cranking camera handles, the camera was cloistered in a glass booth. Even with these precautions the oil company took out third party insurance.

The picture is a fine tribute to the oil industry and contains a theme of a certain educational value on the producing and marketing of oil. Scenes in oilfield hotels, refineries and equipment supply houses should revive lively memories of the early days of the industry in the west.

Foreign Oil Legion

REGULAR monthly meeting of the Los Angeles chapter of the Nomads was held at the California Country Club in Los Angeles on August 14th. In the absence of the president of the chapter, the meeting was presided over by Sam Bowen, vice-president. Among the guests at the Nomads meeting were: Charles Hauenstein of the Iraq Petroleum Company and C. H. Curtis, recently engaged in geological work for the Y. P. F. in Argentina. Both of these visitors gave brief talks on the conditions in the countries where they have recently been working. Other visitors from abroad were: John Domeroq of the California Arabian Standard Oil Company; H. G. Baker of the Bahrein Petroleum Company; H. C. Creath and R. W. Perry of Ultramar, Argentina; C. K. Banton of British Burmah; A. V. Sardania of the C. N. P., Brazil; James Schaffer of The Texas Company de Colombia; M. H. Bush of Bahrein Petroleum Company, and M. J. Bonzerio of the Y. P. F., Argentina.

Left to right: John C. Case, manager of the producing department, A. F. Corwin, vice-president and Robert Siegel, assistant manager of the producing department of Socony-Vacuum inspecting a new Bi-motor Lockheed-12 which will be used in the company's exploration work in Venezuela.



G. L. EVANGOULOFF, equipment engineer, U. B. O. T., Trinidad, arrived in New York August 19th (S. S. Brazil) for a short vacation. He left New York on August 27 by motor to Miami and plane back to Trinidad.

T. R. Armstrong executive of the Standard Oil Co. of New Jersey sailing aboard the Santa Rosa for two week cruise to Bermuda and South America.

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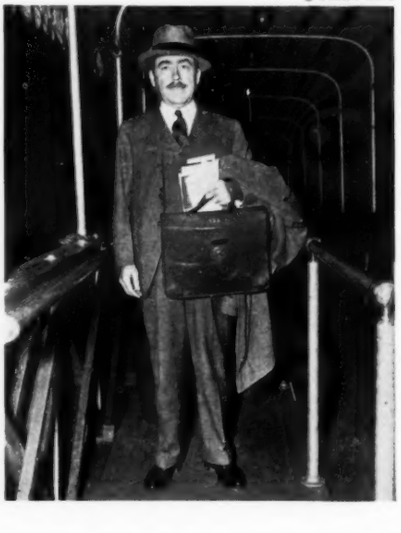

C. E. Olmstead

C. E. OLMSTEAD, vice-president of The Texas Corporation, was recently elected a director of that company. Mr. Olmstead has been connected with The Texas Company for the last seventeen years.

CHANNING R. DOOLEY in charge of industrial relations for the Socony-Vacuum Oil Company, Inc., was recently appointed director of training in industry for the National Defense Advisory Commission. Mr. Dooley will be charged with developing methods of training suitable to provide skilled labor for defense industries, government arsenals and navy yards.

LOUIS CASS, resident geologist, Kuwait Petroleum Co., Ltd., recently returned to the United States on vacation, and is visiting his home in Denver, Colorado, as well as spending some time at the New York offices of Gulf Oil Corporation, which company is exploring and drilling for oil in Kuwait in conjunction with the Anglo-Iranian Oil Co. Ltd.

SEUMAS MACMANUS was one of the first men to prospect for oil in Venezuela. His wife, Senora Catalina Paez MacManus is the granddaughter of General Jose Antonio Paez, the liberator of the South American Republic and a descendant of the conquistadores. In July she flew from New York to Venezuela as the guest of the government and unveiled a monument of General Paez, whose body now reposes in St. Patrick's Cathedral, Manhattan.

CHARLES A. MCCULLOCH, director of The Texas Corporation was recently elected a member of the executive committee. In addition to his duties with The Texas Corporation Mr. McCulloch is a director of the First National Bank of Chicago and the Commonwealth Edison Company, a trustee of the Field Museum of Natural History and a trustee of Northwestern University.

Pete Wallace

PETE WALLACE, oil industry manager, Link-Belt Company of Houston, Texas, leaves Miami on September 19th aboard the Pan American Clipper for a two months tour of the active oil fields in Colombia, Venezuela, and Trinidad. This is Mr. Wallace's second trip to South American oilfields, his previous journey having been made in 1939. He expects to return to the United States in time to attend the annual A. P. I. meeting in Chicago.

MAJOR HARRY DAVIS, well-known to international oil men through his service in charge of the London office of Gulf Oil Corporation and as director of Kuwait Petroleum Co., Ltd. has been spending some time in the United States. At the end of August, Major Davis sailed from New York to take up his new duties as assistant to the president of Mene Grande Oil Company at Caracas, Venezuela.

Major Harry Davis

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E. E. SOUBRY who for several years past has been a member of the council of International Association (Petroleum Industry) Ltd., an advisory organization formed to assist subsidiary companies of Standard Oil Co. (New Jersey) in their marketing operations, has been made chairman of Anglo-American Oil Co. Ltd. Mr. Soubry succeeds Mr. Frederick J. Wolfe who retired from the chairmanship in June last.

W. A. KEIGHTLEY has been appointed London representative of Universal Oil Products Company. Mr. Keightley formerly was assistant to Dr. V. V. Henny whose death some two months ago from the accidental discharge of a weapon he was handling was a severe shock to his many friends throughout the international oil industry.

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Lieutenant Maxwell Williams

LIEUTENANT MAXWELL WILLIAMS, former London representative and manager for American Flange and Manufacturing Company, is now serving with the British armed forces. Lieutenant Williams was recently involved in an unfortunate tragedy, when his wife, Lady Cynthia, only daughter of the Earl and Countess of Gilford and her brother, Lord North were killed when they accidentally exploded a concealed land mine while strolling in a prohibited area on the southeast coast of England.

CLAUDE WOESSNER, assistant vice president of the Mene Grande Oil Company sailed from New York aboard the SS. Santa Rosa on Friday, August 23rd for a business trip to the M. G. O. C.'s headquarters in Caracas, Venezuela.

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Mrs. Henrietta Watson and Miss Martha Watson, wife and daughter of the Maracaibo manager of the Caribbean Petroleum Company (Shell) pictured aboard the SS. Santa Paula as they left New York for their home in Maracaibo on August 30th.

IN THE August issue of WORLD PETROLEUM, in a caption published in connection with a photograph accompanying an item regarding the Axelson Manufacturing Company's 11th Annual Employees Picnic, it was stated that Mr. G. A. Axelson had retired. This statement was in error as Mr. G. A. Axelson, is of course, very active as Chairman of the Board of Directors of the Axelson Manufacturing Company. The editors regret the occurrence of this error.

Edwin S. Hall was elected recently a vice president of the Standard Oil Company of New Jersey incorporated in Delaware, an operating subsidiary of the Standard Oil Company of New Jersey. Mr. Hall has been a director of the company since 1934 and at present is its senior counsel.

WORLD OIL

All figures furnished direct to WORLD PETROLEUM by governments, except where otherwise specified. Figures

U. S. BARRELS

	Aug. 1939	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	Jan. 1940	Feb. 1940	March 1940	April 1940	May 1940	June 1940	Preliminary Figures July. 1940
United States	80,865,000	108,168,000	114,197,800	111,887,000	114,808,500	113,140,700	108,668,800	120,075,000	116,046,000	118,283,000	111,690,000	111,018,730
Soviet Union[4]	18,100,000	18,000,000	18,406,932[1]	17,813,160[1]	18,406,932[1]	18,406,932[1]	17,251,723[1]	18,454,796[1]	17,896,740[1]	18,448,875[1]	17,853,750[1]	18,448,875
Venezuela	18,743,714	18,652,354	19,516,845	16,681,881	16,050,535	14,798,667	14,380,134	15,514,962	16,495,995	18,343,406	18,629,609[1]	16,580,129
Iran[5]	6,637,503[1]	6,423,390[1]	6,637,503[1]	6,423,390[1]	6,637,503[1]	6,637,503[1]	6,227,895[1]	6,745,073[1]	6,507,180[1]	6,560,000[1]	6,449,520[1]	6,664,504
Netherland India: Sumatra	3,550,123	3,502,437	3,600,371	3,427,490	3,629,655	3,472,786	3,149,536	3,440,792[1]	3,428,880[1]	3,456,624[1]	3,345,120[1]	3,456,621
Borneo	1,111,810	865,693	995,207	1,068,349	1,086,713	1,093,743	1,062,210	1,097,516[1]	1,063,890[1]	1,106,080[1]	1,070,400[1]	1,106,000
Java[5]	559,096	511,355	556,658	549,926	633,136	561,064	507,207	562,665[1]	537,720[1]	555,582[1]	537,660[1]	555,582
Molucca[9]	71,767	68,065	64,292	62,340	60,550	59,215	62,340	54,021[1]	67,740[1]	62,310[1]	60,300[1]	62,310
Roumania	3,945,625	3,795,308	3,842,567	3,743,041	3,842,154	3,786,908	3,595,888	3,818,554	4,422,721	4,002,844[1]	3,350,000[1]	3,913,626
Mexico[13]	3,700,000	4,050,000	4,500,000	3,700,000	3,500,000	3,348,682	3,147,385	3,286,000	3,180,000	3,412,000	3,873,720	2,945,000
Iraq	2,615,129[1]	2,530,770[1]	2,615,129[1]	2,530,770[1]	2,615,129[1]	2,615,129[1]	2,461,723[1]	2,666,713[1]	2,578,020[1]	2,644,362[1]	2,559,060[1]	2,644,362
Colombia	1,950,966	1,894,941	1,860,620	1,918,891	1,871,594	2,484,398	2,025,618	2,203,272	2,192,178	2,427,000	2,236,650[1]	2,311,281
Trinidad	1,636,645[1]	1,583,850[1]	1,636,645[1]	1,583,850[1]	1,636,645[1]	1,636,645[1]	1,529,808[1]	1,633,421[1]	1,580,940[1]	1,634,754[1]	1,582,020[1]	1,634,754
Argentine	1,495,806	1,542,755	1,632,997	1,621,927	1,691,123	1,751,910	1,797,072	1,625,981[1]	1,579,350[1]	1,730,420[1]	1,674,600[1]	1,730,420
Peru[3]	1,100,000[1]	1,116,810[1]	1,154,037[1]	1,116,810[1]	1,154,037[1]	1,154,037[1]	1,071,869[1]	1,139,932[1]	1,097,400[1]	1,143,466[1]	1,106,580[1]	1,143,466
Bahrein[6]	698,714	647,595	571,673	563,985	632,962	631,644	581,255	636,577	579,078	616,174	602,560	621,240
Burma[7]	696,317	685,756	710,501	753,771	708,054	666,810[1]	629,039[1]	689,750[1]	666,810[1]	679,520[1]	657,600[1]	679,520
Canada[2]	795,844	720,866	816,257	731,209	502,920	486,859	655,586	570,131	634,869	676,486	657,098	626,973
Brunei[3]	488,777[1]	473,010[1]	488,777[1]	473,010[1]	488,777[1]	488,777[1]	456,576[1]	487,661[1]	471,540[1]	487,940[1]	472,200[1]	487,940
Great Germany: Old Reich[14]	381,114[1]	368,820[1]	381,114[1]	368,820[1]	381,114[1]	381,114[1]	360,383[1]	386,508[1]	371,610[1]	384,183[1]	371,790[1]	384,183
Ostmark[15]	58,869[1]	56,970[1]	58,869[1]	56,970[1]	58,869[1]	58,869[1]	57,072[1]	61,721[1]	61,230[1]	61,194[1]	59,220[1]	61,194
Slovakia and Moravia	11,000[1]	9,810[1]	10,137[1]	9,810[1]	10,137[1]	10,137[1]	9,454[1]	10,106[1]	9,780[1]	10,106[1]	9,780[1]	10,106
Poland	330,000[1]	320,370[1]	331,049[1]	320,370[1]	331,049[1]	331,049[1]	310,155[1]	331,669[1]	320,790[1]	331,421[1]	320,730[1]	331,421
Japan[16]	210,105	222,513	223,016	224,494	223,960[A]	225,308[1]	210,801[1]	224,068[1]	216,960[1]	224,719[1]	217,470[1]	224,719
British India[11]	200,036	212,322	229,422	213,270	228,281	197,532[1]	180,351[1]	189,999[1]	180,090[1]	191,611[1]	185,430[1]	191,611
Ecuador	204,115	193,720	193,382	196,808	205,138	204,509	188,024	211,610	208,513	213,000	201,650	207,700
Saudi Arabia	429,104	538,136	512,590	313,757	437,020	491,663	323,416	606,201	476,359	334,728	356,571	478,243
Sarawak[12]	112,716[1]	109,080[1]	112,716[1]	109,080[1]	112,716[1]	112,716[1]	104,951[1]	112,282[1]	108,330[1]	112,282[1]	108,660[1]	112,282
Egypt[13]	440,678	362,880	420,519	434,174	446,846	438,367	376,043[1]	432,729[1]	454,260[1]	435,891[1]	421,830[1]	433,891
Italian Empire: Albania[16]	89,000[1]	114,540[1]	118,358[1]	114,540[1]	118,358[1]	118,358[1]	112,230[1]	123,411[1]	119,250[1]	121,241[1]	117,330[1]	121,241
Italy	7,600[1]	7,736[1]	7,750[1]	7,500[1]	7,750[1]	7,750[1]	7,250[1]	7,657[1]	7,380[1]	7,688[1]	7,440[1]	6,000
France	42,000[1]	42,653[1]	42,470[1]	41,160[1]	42,532[1]	42,532[1]	39,817[1]	42,439[1]	41,100[1]	42,470[1]	41,100[1]	42,470
Hungary	70,000[1]	65,210[1]	65,317[1]	65,210[1]	65,317[1]	65,317[1]	62,350[1]	67,580[1]	65,580[1]	66,805[1]	64,650[1]	164,000[B]
Bolivia	8,700[1]	7,893[1]	8,556[1]	8,280[1]	8,556[1]	8,556[1]	7,975[1]	8,587[1]	8,310[1]	8,556[1]	8,280[1]	8,556
Other Countries[17]	50,700	50,000	49,073	47,490	49,073	49,073	45,849	49,786	48,150	49,383	47,790	49,383
WORLD TOTAL	151,408,573	177,915,608	186,599,149	179,182,533	182,683,635	179,965,259	171,637,785	187,569,170	183,624,743	188,866,121	180,948,168	179,458,762

[A] Estimated official sources.
[1] Estimated W. P.
[2] Includes natural gasoline (naphtha) production.
[3] International Petroleum Company and Lobitos Oilfields, Ltd. figures combined.
[B] Reliable sources indicate large increase in Hungary's production and decrease in Italy's.
[4] Russian Saghalin included with U.S.S.R.
[5] Anglo-Iranian Oil Company, Ltd., figures revised —fuel oil returned to the ground has been deducted.
[6] Bahrein Petroleum Company, Ltd., figures.
[7] Does not include Assam or Punjab, which are listed together under British India.
[8] British Malayan Petroleum Company, Ltd., figures.
[9] Includes Madura.
[*] Includes all other Netherland India.

Daily Averages in Barrels

	Jan.—July 1940	Jan.—July 1939
United States	3,750,808	3,463,811
Soviet Union	595,125	594,339
Venezuela	538,699	547,822
Iran	214,984	214,113
Netherland India: Sumatra	111,504	112,485
Borneo	35,680	37,301
Java	17,922	17,728
Molucca	2,010	2,352
Roumania	126,246	126,241
Mexico	108,886	94,236
Iraq	85,302	84,359
Colombia	74,555	59,149
Trinidad	52,734	52,795
Argentine	55,820	50,344
Peru	36,886	37,482
Bahrein	20,040	21,102
Burma	21,920	20,263
Canada	20,225	20,143
Brunei	15,740	15,767
Great Germany: Old Reich	12,393	12,294
Ostmark	1,974	1,899
Slovakia and Moravia	326	323
Poland	10,691	10,684
Japan	7,249	7,305
British India	6,181	5,929
Ecuador	6,737	7,221
Saudi Arabia	14,339	8,034
Sarawak	3,622	3,636
Egypt	14,061	11,786
Italian Empire: Albania	3,911	3,957
Italy	248	249
France	1,370	1,367
Hungary	2,611	2,075
Bolivia	276	277
Other Countries	1,593	1,564
WORLD TOTAL	5,972,253	5,649,240

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Barrels

	1939	1938	1937	1936	1935	1934	1933
United States	1,264,256,000	1,214,355,000	1,279,160,000	1,098,516,000	996,596,000	908,065,000	905,656,000
Soviet Union	216,727,024	206,192,000	201,856,661	199,635,921	184,008,033	175,635,783	155,596,429
Venezuela	205,783,585	188,429,050	187,675,477	155,270,840	148,809,057	136,098,681	117,113,940
Iran	78,151,332	78,320,840	78,109,001	62,977,950	57,520,488	57,902,092	54,440,075
Netherland India: Sumatra	41,557,020	34,538,128	33,451,511	30,469,428	28,004,595	26,336,011	22,345,172
Borneo	13,125,425	12,812,383	12,960,072	13,068,910	13,529,185	14,335,543	15,003,175
Java	6,568,660	6,955,283	7,152,931	3,618,293	3,462,440	3,778,920	3,600,816
Molucca	836,144	607,622	537,436	375,823	311,872	273,698	285,335
Roumania	45,931,846	48,366,000	52,395,725	63,532,846	61,270,072	61,849,306	53,919,700
Mexico	39,428,141	38,505,824	46,455,687	41,027,915	40,240,563	38,171,946	34,000,830
Iraq	30,791,132	32,404,000	30,603,660	29,913,150	27,410,983	7,639,849	1,094,915
Colombia	22,036,613	21,581,588	20,297,543	18,756,110	17,597,655	17,337,900	13,156,126
Trinidad	19,270,256	17,736,176	15,502,989	13,237,030	11,671,224	10,894,363	9,561,353
Argentine	18,613,167	17,076,237	16,354,717	15,457,960	14,297,025	14,021,901	13,690,556
Peru	13,587,906	15,908,279	17,459,112	17,593,069	17,056,555	16,314,381	13,257,318
Bahrein	7,588,554	8,297,998	7,762,264	4,644,635	1,264,807	285,072	31,377
Burma	7,872,981	7,499,498	7,847,553	7,587,718	7,181,113	7,278,859	7,114,311
Canada	7,837,503	6,965,457	2,996,033	1,507,931	1,447,204	1,410,895	1,145,333
Brunei	5,755,164	5,387,214	4,397,038	3,296,938	3,302,905	2,705,350	2,035,656
Great Germany: Old Reich	4,487,491	3,850,044	3,148,300	3,076,858	2,967,438	2,204,402	1,656,602
Ostmark	693,247	370,038	221,266	50,092	44,347	27,965	5,765
Slovakia and Moravia	119,380	132,005	123,474	126,603	136,580	177,797	121,695
Poland	3,898,044	3,828,438	3,799,862	3,869,575	3,901,881	4,011,336	4,174,079
Japan	2,652,930	2,511,184	2,487,841	2,403,072	2,294,878	1,872,837	1,504,412
British India	2,332,467	2,330,209	2,161,653	1,978,329	2,037,810	1,921,863	1,628,803
Ecuador	2,312,118	2,257,278	2,161,436	1,942,467	1,731,785	1,636,619	1,619,902
Saudi Arabia	3,933,904	495,135	64,968	19,777	Nil	Nil	Nil
Sarawak	1,327,327	1,624,882	1,655,565	1,547,882	1,776,593	1,942,591	2,206,815
Egypt	4,602,797	1,561,231	1,163,267	1,262,666	1,255,151	1,527,252	1,653,535
Italian Empire: Albania	1,393,727	437,597	380,292	219,693	41,218	17,500	11,437
Italy	91,330	106,083	112,700	129,653	128,615	162,449	213,534
France	500,815	516,240	507,067	534,063	529,664	700,000	786,366
Hungary	769,092	330,829	13,910	100	Nil	Nil	Nil
Bolivia	100,885	106,620	123,123	104,746	163,295	157,875	111,973
Other Countries	578,036	243,000	70,000	37,100	32,300	64,000	54,100
WORLD TOTAL	2,075,512,043	1,982,639,390	2,041,170,134	1,797,791,150	1,652,023,331	1,516,760,036	1,438,797,443

PRODUCTION

Figures in U. S. barrels of 42 gal.—Conversion ratios used are weighted averages for individual countries

METRIC TONS

	Aug. 1939	Sept. 1939	Oct. 1939	Nov. 1939	Dec. 1939	Jan. 1940	Feb. 1940	March 1940	April 1940	May 1940	June 1940	Preliminary Figures July, 1940
United States	10,941,000	14,635,096	15,450,953	15,138,276	15,533,757	15,307,901	14,702,854	16,246,164	15,700,987	16,003,653	15,111,622	15,020,802
Soviet Union[1]	2,480,000	2,300,000	2,508,024[1]	2,427,120[1]	2,508,024[1]	2,508,024[1]	2,360,194[1]	2,531,522[1]	2,436,780[1]	2,520,083[1]	2,438,790[1]	2,520,083
Venezuela	2,783,031	2,769,466	2,897,824	2,476,894	2,383,153	2,197,278	2,135,135	2,303,632	2,449,294	2,723,594	2,766,089[1]	2,461,786
Iran[2]	880,493[1]	852,090[1]	880,493[1]	852,090[1]	880,493[1]	880,493[1]	826,152[1]	894,753[1]	863,190[1]	870,212[1]	855,540[1]	884,058
Netherland India: Sumatra	454,503	448,398	460,936	438,803	464,685	444,602	403,218	440,506[1]	438,960[1]	432,525[1]	426,270[1]	440,479
Borneo	142,339	110,830	127,411	136,775	139,126	140,026	135,989	140,509[1]	136,290[1]	141,608[1]	137,040[1]	141,606
Java[3]	71,578	65,466	71,266	70,404	81,057	71,830	64,935	72,035[1]	68,820[1]	71,114[1]	69,210[1]	71,176
Molucca[4]	9,188	8,842	8,231	7,981	7,752	7,581	7,981	6,916[1]	8,670[1]	7,967[1]	7,710[1]	7,967
Roumania	535,000	514,618	521,026	507,531	520,970	513,479	487,578	517,770	599,691	542,748[1]	525,240[1]	542,748
Mexico[13]	543,316	594,713	660,973	543,318	513,950	492,094	462,171	482,525	466,960	501,028	491,923	432,452
Iraq	349,556[1]	338,280[1]	349,556[1]	338,280[1]	349,556[1]	349,556[1]	330,034[1]	356,531[1]	344,670[1]	353,741[1]	342,330[1]	353,741
Colombia	272,101	264,287	257,920	267,627	260,524	346,499	282,512	307,290	305,745	338,493	311,940[1]	322,338
Trinidad	230,206[1]	222,780[1]	230,206[1]	222,780[1]	230,206[1]	230,206[1]	215,151[1]	229,710[1]	222,360[1]	229,896[1]	222,480[1]	229,896
Argentine	213,077	219,765	232,620	231,043	240,900	249,559	255,993	231,601[1]	224,970[1]	246,481[1]	258,270[1]	249,829
Peru[5]	146,000[1]	147,810[1]	152,737[1]	147,810[1]	152,737[1]	152,737[1]	141,810[1]	150,784[1]	145,200[1]	151,280[1]	146,400[1]	151,280
Bahrein[6]	95,348	87,030	78,012	76,963	86,375	86,195	79,319	87,017	79,022	84,084	82,227	84,785
Burma[7]	96,176	94,717	98,135	104,112	97,797	92,101[1]	86,855[1]	94,147[1]	91,980[1]	93,527[1]	90,510[1]	93,527
Canada[8]	101,278	91,736	103,875	93,052	64,001	61,957	83,429	72,554	80,792	86,088	83,621	79,763
Brunei[9]	65,193[1]	63,090[1]	65,193[1]	63,090[1]	65,193[1]	65,193[1]	60,900[1]	65,038[1]	62,880[1]	65,069[1]	62,970[1]	65,038
Great Germany: Old Reich[14]	58,300[1]	53,190[1]	54,963[1]	53,190[1]	54,963[1]	54,963[1]	51,997[1]	55,800[1]	53,940[1]	55,490[1]	53,700[1]	55,490
Ostmark[15]	13,000[1]	9,030[1]	9,331[1]	9,030[1]	9,331[1]	9,331[1]	9,048[1]	9,827[1]	9,780[1]	9,703[1]	9,390[1]	9,703
Slovakia and Moravia	1,600[1]	1,550[1]	1,519[1]	1,470[1]	1,519[1]	1,519[1]	1,421[1]	1,519[1]	1,470[1]	1,519[1]	1,470[1]	1,519
Poland	45,000[1]	42,960[1]	44,392[1]	42,960[1]	44,392[1]	44,392[1]	41,644[1]	44,516[1]	43,050[1]	44,454[1]	43,020[1]	44,454
Japan[9]	31,721	31,651	31,723	31,933	31,857[A]	32,178[1]	30,131[1]	32,023[1]	31,020[1]	32,085[1]	31,050[1]	32,085
British India[11]	27,629	29,326	31,688	29,457	31,530	27,280[1]	24,911[1]	26,226[1]	24,870[1]	26,443[1]	25,590[1]	26,443
Ecuador	26,910	25,540	25,495	25,947	27,045	26,962	24,788	27,898	27,490	28,081	26,585	27,382
Saudi Arabia	58,129	72,899	72,899	42,503	59,201	66,604	43,812	82,120	64,531	45,344	48,304	64,785
Sarawak[12]	14,539[1]	14,070[1]	14,539[1]	14,070[1]	14,539[1]	14,539[1]	13,543[1]	14,415[1]	13,920[1]	14,446[1]	13,980[1]	14,446
Egypt[13]	62,936	51,810	60,057	62,150	63,817	62,606	53,534[1]	58,125[1]	57,150[1]	59,272[1]	57,360[1]	59,272
Italian Empire: Albania[16]	13,000[1]	17,100[1]	17,670[1]	17,100[1]	17,670[1]	17,670[1]	16,762[1]	18,415[1]	17,790[1]	18,073[1]	17,490[1]	18,073
Italy	950[1]	961[1]	961[1]	930[1]	961[1]	961[1]	899[1]	930[1]	900[1]	930[1]	900[1]	546[B]
France	6,000[1]	5,760[1]	5,952[1]	5,760[1]	5,952[1]	5,952[1]	5,568[1]	5,952[1]	5,760[1]	5,952[1]	5,760[1]	5,952
Hungary	9,500[1]	8,490[1]	8,773[1]	8,490[1]	8,773[1]	8,773[1]	8,381[1]	9,052[1]	8,760[1]	8,928[1]	8,640[1]	22,063[B]
Bolivia	1,000[1]	960[1]	992[1]	960[1]	992[1]	992[1]	928[1]	992[1]	960[1]	992[1]	9,600	993
Other Countries.[17]	7,100	7,000	6,975	6,750	6,975	6,975	6,525	7,006	6,780	7,223	6,810	7,223
WORLD TOTAL	20,786,697	24,201,311	25,543,320	24,496,649	24,959,773	24,579,008	23,456,102	25,625,820	25,093,432	25,822,126	24,781,191	24,543,783

[1] Japanese Saghalin, Taiwan (Formosa) and Hokkaido included with Japan.
[2] Excluding Burma.
[3] Sarawak Oilfields, Ltd., figures.
[A] Estimated Official Sources
[B] Anglo-Egyptian Oilfields, Ltd., figures.
[4] Prussia, Thuringia and Baden.
[5] Formerly known as Austria.
[6] Italian imports of Albanian crude oil.
[7] Includes all other Netherland India.
[8] Estimate representing Morocco, Cuba, New Zealand, Barbados, Greece, Algeria, Yugoslavia, Australia, Great Britain, Kuweit and China.
[9] Official Figures—Petroleos Mexicanos.

Daily Averages in Metric Tons

	Jan.—July 1940	Jan.—July 1939
United States	507,483	468,650
Soviet Union	81,293	81,636
Venezuela	79,985	81,242
Iran	28,518	28,403
Netherland India: Sumatra	14,209	14,400
Borneo	4,568	4,808
Java	2,296	2,269
Molucca	257	302
Roumania	17,508	17,117
Mexico	15,629	13,858
Iraq	11,411	11,276
Colombia	10,398	8,231
Trinidad	7,416	7,426
Argentine	8,059	7,161
Peru	4,880	4,959
Bahrein	2,735	2,876
Burma	3,017	2,798
Canada	2,573	2,563
Brunei	2,099	2,104
Great Germany: Old Reich	1,790	1,758
Ostmark	313	283
Slovakia and Moravia	49	49
Poland	1,434	1,430
Japan	1,035	1,039
British India	853	818
Ecuador	888	829
Saudi Arabia	1,950	1,088
Sarawak	466	469
Egypt	1,912	1,682
Italian Empire: Albania	583	593
Italy	28	31
France	192	192
Hungary	350	279
Bolivia	32	33
Other Countries	227	224
WORLD TOTAL	816,448	772,916

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Metric Tons

	1939	1938	1937	1936	1935	1934	1933
United States	171,053,443	164,346,325	172,822,797	148,707,864	134,912,143	122,913,903	122,601,191
Soviet Union	29,530,168	28,859,000	27,867,025‡	27,384,900	25,241,100	24,092,700	21,330,100
Venezuela	30,533,706	27,845,286	27,733,926	22,945,299	21,990,373	20,112,115	17,293,193
Iran	10,367,112	10,358,495	10,330,480	8,329,289	7,607,500	7,657,970	7,200,093
Netherland India: Sumatra	5,320,320	4,662,836	4,490,137	4,114,710	3,759,006	3,535,035	2,999,352
Borneo	1,680,377	1,719,783	1,739,607	1,773,545	1,815,998	1,924,234	2,013,849
Java	840,950	933,595	960,125	499,097	464,757	510 320	483,331
Molucca	107,047	81,560	72,139	50,446	41,862	36 738	38,300
Roumania	6,228,047	6,603,000	7,153,000	8,704,000	8,394,000	8,473,355	7,387,000
Mexico	5,794,215	5,716,423	6,896,657	6,090,842	5,973,955	5,666,857	5,049,109
Iraq	4,115,845	4,345,000	4,126,185	4,079,066	3,724,231	1,048,108	147,943
Colombia	3,067,568	3,007,935	2,844,251	2,614,092	2,452,635	2,416,432	1,833,686
Trinidad	2,710,515	2,472,943	2,181,676	1,862,796	1,642,446	1,533,122	1,345,532
Argentina	2,651,448	2,432,857	2,330,063	2,202,304	2,036,903	1,997,706	1,950,499
Peru	1,798,557	9,099,885	2,313,691	2,331,454	2,260,903	2,161,990	1,756,867
Bahrein	1,033,472	1,130,734	1,058,557	635,555	173,072	39,008	4,293
Burma	1,087,424	1,039,960	1,083,391	1,047,593	991,456	1,004,951	982,233
Canada	997,391	879,921	378,478	190,495	182,820	178,233	144,686
Brunei	767,700	707,123	576,545	470,991	471,842	386,478	290,808
Great Germany: Old Reich	647,337	552,074	453,451	444,600	427,400	317,500	238,600
Ostmark	109,904	63,468	33,010	7,473	6,616	4,172	860
Slovakia and Moravia	18,103	19,282	18,036	18,665	19,946	25,971	17,776
Poland	522,874	504,678	501,301	510,630	614,760	529,200	550,670
Japan	379,161	356,328	341,040	341,976	326,580	266,520	212,667
British India	322,160	322,125	298,450	273,137	281,072	265,341	224,879
Ecuador	306,824	319,877	306,326	275,293	245,434	231,947	229,578
Saudi Arabia	536,366	66,683	8,070	2,447	Nil	Nil	Nil
Sarawak	171,322	200,126	217,085	221,126	253,799	277,513	315,259
Egypt	657,510	223,058	166,298	177,491	176,436	214,671	232,437
Italian Empire: Albania	208,279	65,313	56,760	32,760	6,152	2,500	1,707
Italy	11,346	13,178	14,000	16,106	15,977	20,180	26,526
France	70,224	72,106	71,008	74,788	74,172	98,025	110,120
Hungary	103,364	42,798	13,910	13	Nil	Nil	Nil
Bolivia	11,904	13,262	15,487	13,197	20,540	19,858	14,085
Other Countries	82,300	34,080	10,000	5,300	4,600	9,100	7,700
WORLD TOTAL	283,844,283	279,111,097	279,482,962	246,449,340	226,610,486	207,971,753	197,034,849

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Petroleum Industry. Edited by Dr. O. W. Willcox

Remote Control Seismic Instruments—P. M. Honnell, in OIL WEEKLY, Vol. 98 (1940), No. 1, pp. 23-26.

Seismic exploration of many Gulf Coast areas is seriously hampered—when not rendered totally impossible—by transportation difficulties, particularly where water is too shallow for boats or marshes have too much brush for marsh buggies. The equipment required for seismic prospecting can then be transported only by man-power. Since this is generally a costly and inconvenient procedure, any profiles obtained in such areas are necessarily of limited extent.

Remote-control seismic instruments are designed to make feasible the explorations of such otherwise inaccessible regions. This is accomplished by keeping all the heavier recording equipment at a fixed location. The shot-point and seismometers are moved progressively along the desired profile with transmission lines connecting the seismometers to the recording oscillograph at the stationary positions. The transmission lines are constructed of inexpensive wire, supported on stakes or shrubbery. This wire can be retrieved and used again or abandoned, depending upon the terrain or economic factors. Line construction usually continues in advance of the actual shooting, thus speeding up operations.

The transmission lines may extend for a distance up to five miles from the recording station; single wire line with ground return may be used, but it is better to use a double wire circuit which avoids the possible effect of static bad thunderstorms or transient earth currents.

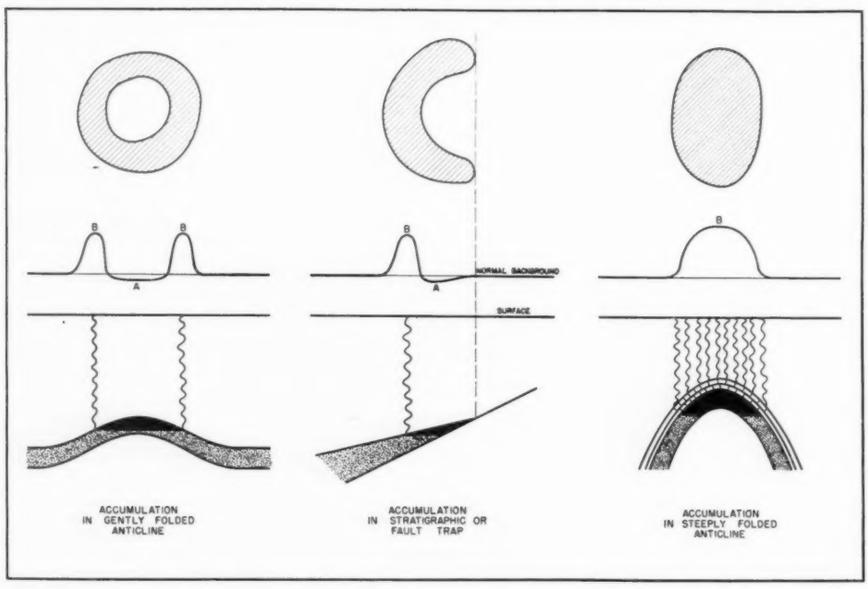
Geochemical Exploration (Soil Analysis). Eugene McDermott in BULLETIN AMERICAN SOCIETY PETROLEUM GEOLOGISTS, Vol. 24 (1940). No. 5, pp. 859-881 (11 figs.).

In here setting forth the facts and theories underlying the newly developed methods of geochemical exploration for oil the author recalls that most of the great oil fields of the world have been indicated by surface evidence, such as oil and gas seeps that were plainly apparent. Hence it is reasonable to expect that seeps of smaller size, even microscopic, might be found in much greater abundance. The existence of small seeps in the surface above oil and gas deposits has now been convincingly proved and has given explorers for oil a new tool.

The geochemical oil explorer depends on certain general ideas. At the base it is recognized that small quantities of hydrocarbons are found in the soil everywhere as a natural result of decomposition of organic matter. This widely diffused, more or less uniform presence of soil hydrocarbons of uncertain origin is called the "background". When the explorer analyzes soil and finds certain areas with more traces of hydrocarbons than the "background" shows, he has *prima facie* evidence of the presence of oil or gas underneath.

The shape of the area which shows this enrichment indicates the type of the underlying structure. If the latter is an anticline, the gas accumulations in the soil will be a "halo" or ring-shaped area, as in the left of the accompanying diagram. If the structure is a stratigraphic or a fault trap the halo will approximate a half-moon, as in the right of the diagram. This is because the gas or oil is supposed to escape from the structure at the lower edges of the oil body.

Practical confirmations of these relations are cited from the Cedar Lake area and La Rosa field in Texas, the Monument and Hobbs fields in New Mexico, and various fields in California. An interesting fact is that the gas halos usually coincide with an extra content of soluble minerals in the soil.



DRILLING

Effect of Formation Permeability on the Plastering Behavior of Mud Fluids—H. T. Byck, before AMERICAN PETROLEUM INSTITUTE, Fort Worth, Meeting, May, 1940.

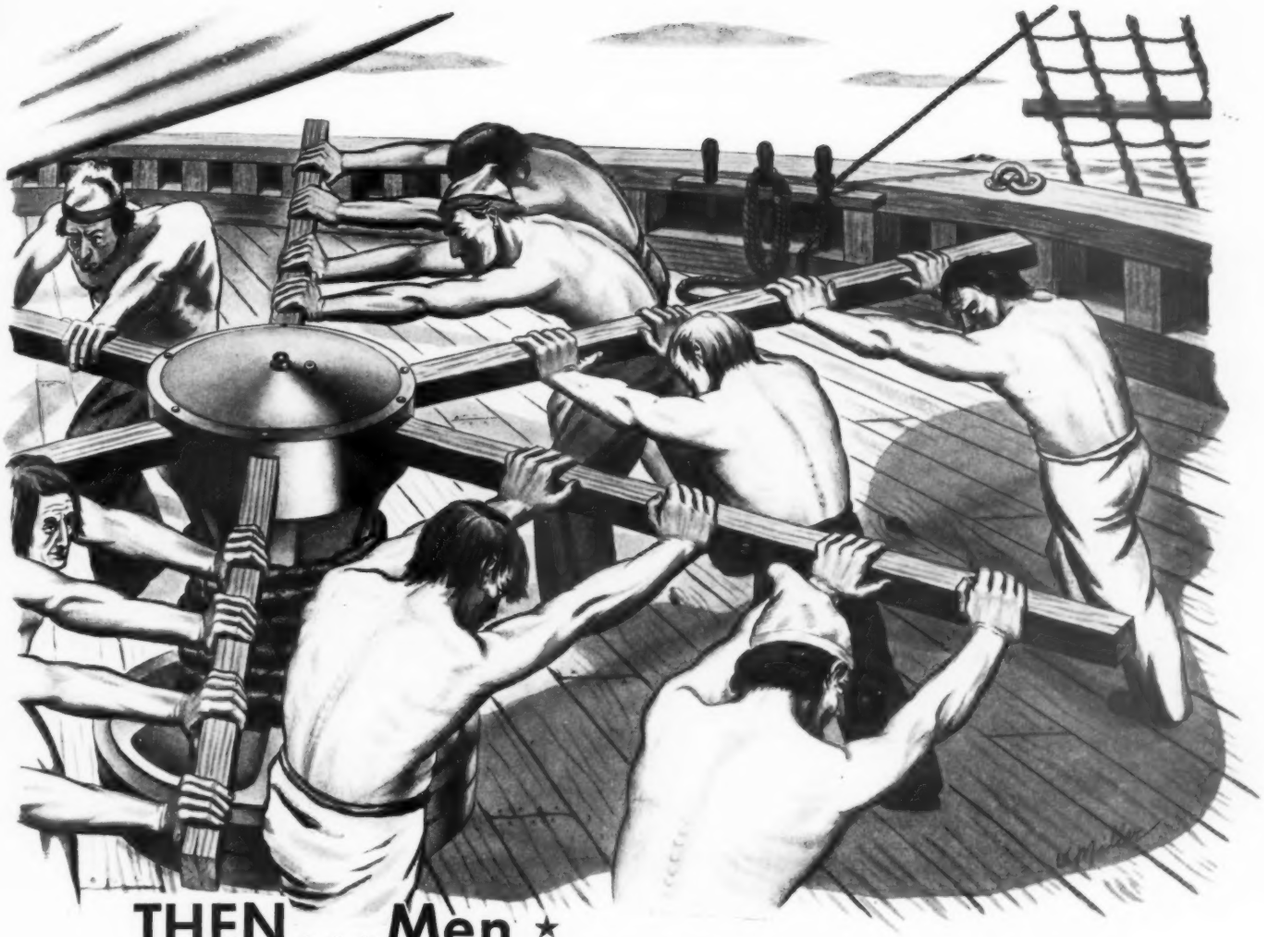
It frequently has been assumed that the loss of liquid from drilling mud increases with increased permeability of the formation penetrated. Several recent papers, which present a theoretical analysis of the filtration of muds, point out that this factor should have little or no influence upon mud plastering. The present paper presents extensive experimental data to check this important point.

In order to establish the influence of this property of the formation upon water loss and sheath thickness, plastering experiments were made, with a number of representative California muds, on a high-pressure circulating filter press using a series of real and synthetic consolidated cores whose permeabilities ranged from 10 to 14,600 millidarcys.

As a result of these experiments, it is concluded that, within these limits in unfractured consolidated cores, the plastering behavior is, in fact, dependent only upon properties of the mud fluid and, hence, independent of the formation permeability.

Mica in Drilling Muds. Issued by NATIONAL LEAD CO., Baroid Division, 1940.

Although this publication is a piece of advertising literature it refers to an interesting development which involves the addition of flake mica to drilling muds. A two-fold purpose is served. First the continual loss of water to uncased formations by filtration through the mud cake is reduced; and second, mica is found to be effective in overcoming cases of mild loss of circulation



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However, the pressure that we would avoid is more imagined than real. We have learned to transfer the burden of toil from men to machines . . . thus providing more individual leisure.

A tank containing oil and sludge may be allowed to stand for several days to afford time enough for gravity to effect a separation (at best, imperfect). The same mixture may be passed through a Centrifugal, wherein the force of gravity is multiplied by the thousands . . . the job of separation is done efficiently in a few minutes . . . and there is involved but a minimum of human effort.

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especially to non-fractured but porous formations ("thief sands").

The mica is used in relatively large flakes similar to the grade used for coating roofing papers, although wide variations are permissible if both large and small flakes are present.

The mica is added to the mud in proportions of from 2 percent to 5 percent by weight, varying the quantity and number of additions as circumstances dictate. It is usual to add a considerable quantity of the mica over a relatively short period of time, say half an hour, not repeating the treatment until several hours later. It is found that the mica apparently becomes entrained in the mud cake built up on the walls of the formation, even after the mud cake has been formed. Thus the mica gradually disappears from the mud, the bulk thereof disappearing relatively soon after its addition. If a vibrating screen is used, with this method of addition it is necessary to bypass the vibrating screen for only a short time after the treatment with mica, since after a short time the larger flakes which would be taken out by the screen will either have been imbedded in the filter cake or broken down to a smaller size. It is occasionally desirable to use mica in conjunction with Fibrotex in combating lost circulation. While this may not always influence the ability of the Fibrotex to form a seal in the first instance, it may result in a more complete seal than could be obtained with either material alone.

The reduction in water loss brought about by the addition of mica to a drilling mud may be readily demonstrated in the laboratory. A 2 percent to 4 percent addition of a properly selected grind of mica will generally reduce the water loss (where the mica is present in the mud from the start) by 50 percent when the mud is tested against filter paper. If uncompacted sand of say 14 to 28 mesh is used in place of filter paper in the wall-building tester, the addition of mica will enable a cake of good wall-building properties to be formed, where with no mica present most muds would pass directly through the sand without ever forming a cake, or forming a cake in any case only after a considerable quantity of the mud had passed through.

Effect of Temperature and Pressure on Rheological Properties of Cement Slurries—R. Floyd Farris, in PETROLEUM TECHNOLOGY, Vol. 3 (1940), No. 2, Technical Publication No. 7; 14 pages.

A thorough knowledge of the behavior of cement slurries under elevated temperatures and pressures is necessary in order to solve properly the many problems presented in deep-well cementing operations. The search for new reserves has extended drilling to such depths that bottom-hole temperatures of more than 200 deg. F. and bottom-hole pressures of 3,000 to 5,000 lb. are not uncommon. Moreover, there is every indication that within the next few years wells will be drilled to even greater depths and bottom-hole temperatures and pressures will be correspondingly higher than those with which we are concerned today.

Using a high pressure "consistometer" an experimental investigation showed that the effect of high pressure is to accelerate greatly the stiffening and setting of a cement slurry.

The effect of high temperature in connection with high pressure is to accelerate further the stiffening and setting of a cement slurry.

At a pressure of 5,000 lb. and 180 deg. F., most of the cements tested stiffen too rapidly to permit proper placement in a deep well. At the same pressure and 220 deg. F., all the cements tested stiffen beyond the limit of mobility immediately.

Agitating a slurry at high pressures after rapid stiffening begins is detrimental to strength of the set cement.

The point on the consistency-time curves where rapid stiffening begins should be regarded as the maximum recommended pumping time, instead of using any assumed viscosity or consistency limit, such as 40 "poises," as a "limit of pumpability."

The practical solution of many of the present and future high-pressure and high-temperature cementing problems will probably be solved when cements are improved so as to permit the placement of a uniform, mobile, and good quality slurry at any given practical high temperature and pressure.

Economies of Slim-hole Drilling—F. W. Heiser, in OIL AND GAS JOURNAL, Vol. 39 (1940), No. 37, pp. 56-57; 60.

This paper considers slim hole drilling from the standpoint of conditions in Kansas. A slim hole is defined as a small diameter hole for producing through 5½ inch or smaller casing. The tendency in Kansas is definitely toward a 6¼ inch hole for 4½ inch. o. d. casing. The drilling of such holes calls for the use of a slim-hole rig, which is a unit carrying its own derrick, draw works, rotary table power, and pumps, all unitized on: (a) a truck; (b) one large skid; or (c) several small skids.

The present popularity of the slim hole outfit is explained by the following circumstances: Prior to 1937 a large-scale drilling campaign caused a great reduction in the allowable production per well, which has had the effect of extending the pay-out of well investments as much as ten years in some cases. The result was that operators found that they could not make profits unless the cost of drilling and equipping new wells were reduced. The answer to the problem has been found in the use of light equipment previously designed for making exploratory tests, and which Gulf Coast operators had successfully turned to account for producing through small pipe.

The lessened expense has enabled Kansas operators to save from $3,000 to $4,000 in the drilling cost per well, as compared with the use of heavy equipment for drilling large holes by the conventional methods. The moving, setting up and dismantling time is much reduced, but perhaps the major saving is in the smaller cost (about 50 percent) of the 4½ inch casing.

Actually, the slim-hole technique involves no new principle and its only merit seems to be its economy. It does very well for the ordinary shallow well, but the small hole may become a handicap when it becomes necessary to go deeper after the slim-hole casing has been set, or where it is necessary to handle volumes of liquid beyond the capacity of a 2-inch pipe.

Developments in Eastern Interior Basin—Alfred H. Bell, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 24 (1940), No. 6, pp. 959-969.

This survey refers to oil fields in Illinois, southwestern Indiana and western Kentucky, with special reference to new limestone production in western Illinois.

Although Mississippian rocks continue to contribute the major part of the oil produced in this region, the outstanding new feature is the discovery and development of Devonian limestone wells in five pools, Sandoval, Salem, Bartelso, Centralia and Tonti (in order of discovery). The saturated zone in the Devonian consists of dolomitic limestone with solution cavities, and probably fissures and joints. In the pools listed the top of Devonian limestone lies from 1,100 to 1,400 feet below the McClosky oolitic limestone (the lowest large producing zone in the Mississippian), and this interval probably increases to more than 2,000 feet in the deepest part of the basin. Initial productions of the new Devonian wells are exceptionally high for the area, some exceeding 10,000 barrels per day, thus indicating a high degree of permeability of the oil-bearing rock.

Thus far all the new areas of Devonian production are on structural closures indicated in Mississippian or Pennsylvanian key beds (or both) and furthermore are in areas of previous production from shallower strata. Whether or not there are structures affecting Devonian, but not younger strata and of sufficient size to cause oil accumulation is not yet known.

Practical Utilization of Rate-of-Penetration Drilling Data—C. A. Yeatman, before AMERICAN PETROLEUM INSTITUTE, Fort Worth Meeting, May, 1940.

The advantages of supplementing the driller's log with precise records of rate-of-penetration are discussed from various angles. One important fact is that in many cases, but not in all, the diagram of the rate at which hole is being made readily correlates with the Schlumberger diagram, with the difference that the information is developed while the hole is being made and not after the well is finished, and gives hints in determining coring intervals in wildcat wells.

An important function is that it provides an accurate means of analyzing the economy of drilling-bit-renewal practices.

It can be demonstrated readily that, when relatively uniform formations are being penetrated, the bit should be renewed when:

$$R = \frac{E}{\frac{C}{K} + D + F}$$

Where:

R = rate of penetration, in feet per hour.
E = total footage drilled by the bit.
C = cost of the bit, in dollars.
K = cost of rig operation, in dollars per hour.
D = round-trip time, in hours.
F = drilling time on bottom, in hours.

When the performance of a given bit is plotted as hours on bottom vs. feet drilled, the time at which economy is served best by bit renewal evidently is portrayed graphically as that point on the plotted curve at which the tangent equals the expression

$$\frac{E}{\frac{C}{K} + D + F}$$

Application of graphic analysis to bit operations will show whether a given bit has been removed prematurely, or has received excessive use, or has given optimum economy performance.

Removing of Drilling Mud from Formation by Use of Acid—Stanley C. Morian, in PETROLEUM ENGINEER, Vol. 11 (1940), No. 8, pp. 117-118-120.

The mud fluids used in drilling wells often penetrates into the sand face and sometimes completely stops production. Various devices are used to remove the mud sheath, such as commercial hydrochloric acid, various mud thinners, mechanical washers and acid-soluble

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mud. These acid-soluble muds consist of lime or similar material.

A mud-acid of unspecified nature has now been introduced by Dowell Inc. which it is said can be used in any type of well regardless of the type of mud used; it dissolves not only limestone and dolomite but also the silicates used in mud (this suggests hydrofluoric acid.—Ed.) but is not reactive on iron and most other metals used in oil-well equipment. It has a surface tension as low as that of oil, so that it has good penetrating, and washing properties like those of soap.

OPERATION

Oil Development and Production Practices in the Gulf Coast Area—George B. Corless and Fred N. Wise, before AMERICAN PETROLEUM INSTITUTE, Division of Production, S. W. District, Houston, March, 1940.

This paper is mostly confined to two principal matters: improvements in drilling practices within the past 10 years and the methods made necessary by proration.

Instead of former much "unnecessary drilling" the Gulf Coast is now developing pools with 10 to 14-acre spacing. Ten years ago a rig more often took 10 days; now it is less than 24 hours, saving $1,000 per well. Formerly round trips took a third of the drilling time; now it is about one-fifth. Drilling speed has increased from 5 to 50 ft. per hour and service per bit has increased from 75 to 1,000 ft. (thanks to improved metallurgy). The wire line retractable core barrel has almost completely replaced conventional coring, with a great saving of exploration costs. Coring cost itself is almost eliminated by electrical well logging, mud-ditch gas and oil detectors, and side wall coring; ditch-logging for oil and gas is a quite recent acquisition.

Larger mud pumps have increased drilling speeds, helped by full opening tool joints. Mud control is now so scientific that it is possible to drill 8,000 ft. or more of open hole without protection casing.

Routine drilling has been speeded up by 5 or 6 times; 10 years ago a 3,000 ft. well could be drilled in 30 days. Now a 6,000 ft. well is put down in 12 days, at $4 or even $3 a foot as against the old cost of $8 a foot.

Proration, which has made smaller casing and flow strings possible, has materially contributed to this reduced cost, making a saving of more than $4,000 for a 7,000 ft. well. The most recent designs of Christmas trees which close in a prorated well without damage cost about $1,000 less than the open flow type.

Proration has affected flow line design in two ways: smaller diameters can be used, but corrosion resisting coverings are needed for long time production, which about balances the saving. If potentials were taken on ⅛ instead of ¼ inch chokes a saving in cost of line could be effected.

Since under proration definite amounts of oil must be produced daily, well control at the tank battery is desirable, which means a saving in operating labor; a stock of 1 or ¾-in. needle valves will handle the restricted amount of oil, again meaning a smaller cost per well. Fewer and smaller lease tanks are required.

Investment in gasoline plants has been encouraged in fields with large gas reserves by reduced rates of production because there is some assurance of a regular supply of gas for a long time; on the other hand, maintenance of pressure by returning gas to the reservoir is less attractive because, under low rates of flow, most Gulf Coast fields are able to rely on the action of a powerful water drive.

Reduced rates of production have aggravated the oil producers' paraffin problems manyfold. Slowly flowing oil is an excellent condition for paraffin deposition in tubing and flow lines. Flow lines can be kept clear in some cases by flushing them at a high rate of flow occasionally during hot weather, but mechanical means have so far proved best for cleaning tubing. Paraffin in the tubing may be drilled up with a bit on a wire line or by means of a scraper actuated by the flow of oil.

Practical Aspects of Water Flooding in Eastern Oklahoma and Kansas.—Lynn C. Converse and R. R. Hawkins, before AMERICAN PETROLEUM INSTITUTE, Division of Production, Wichita, March, 1940; 8 pages.

Prior to 1938 there were 3,969 acres put under flood in Oklahoma, with a projected total ultimate yield of 8,355,000 bbl., which at an average price of $1.10 per bbl. will net the operators a loss of $775,400 or $145 per acre. This is an average figure for the whole territory, which is occupied by a total of 17 operators; at least 30 percent of the Oklahoma area proved distinctly submarginal, where the loss was more than $1,000 per acre. On the other hand five of the best Oklahoma floods will show an average profit of $934. Twelve early Kansas floods (711 acres) came out with a profit of $148 per acre and 271 acres showed a direct loss of $1,372 per acre. However the five best Kansas mark up a profit of $950 per acre.

It is noted that 70 percent of the Oklahoma flooded acreage and 40 percent of the acreage in Kansas is owned and operated by experienced Pennsylvanians with Bradford experience. In view of the vast amount of scientific knowledge and expert practice from flooding experience in the Bradford area the question is raised as to how there could be such a large number of unprofitable floods in the Mid-Continent? The answer is that many of the factors developed for the Bradford sand and oil characteristics proved inapplicable to Mid-Continent conditions. For one thing the viscosity of Bradford oil is fairly constant, which is not the case with Bartlesville and Cherokee oils. Core interpretations by Bradford experience were grossly misleading. The experienced operators had to learn their lessons all over again. Specific causes of failure are listed as too low saturation; channeling by previous air repressuring operations; too wide spacing for the viscosity found; too high and improper setting of packers in input wells; and failure to use proper pressures.

The principal lesson learned by this hard experience is to take nothing for granted and not to rely on assumed standards. Each input well is cored, the core profile is worked out and corrective shooting is done accordingly. A sample of the oil is properly taken and transported to the laboratory in a pressure bomb. With the viscosity of the oil and the permeability of the sand known, the proper spacing of water to oil can be figured.

One big error that was inherited from Bradford was close spacing and the use of standard patterns whether the sand had a permeability of 20 or 80 millidarcys. The actual permeability being known, and also the viscosity of the oil, the pressure can be determined as a function of the time allotted to the project. Experience shows a very marked economy in adapting maximum pressure to maximum spacing.

Another imported Bradford practice was pumping, which is still followed by most of the Mid-Continent operators. However, it turns out that most of the wells can be made to flow by water and pressure, and that 100 bbl. of water can be pumped in for the expense of lifting 1 bbl. of oil; further, 20 percent more oil must be recovered to pay the lifting cost, hence the economy is all in favor of flowing. Moreover, it has been demonstrated in the Nowata field that the ultimate recovery by flowing may be as much as 20 percent more than with pumping.

The authors show a curve, using set conditions of permeability, viscosity, pressure and time, spacings and depths. All other conditions being equal, acreage yielding as low as 1,500 bbl. per acre can be flooded without loss.

Artificial Lift Methods in the Rodessa Field—B. J. Dowd, before AMERICAN PETROLEUM INSTITUTE, Division of Production, Houston, March, 1940.

In the Rodessa field many types of artificial lift are being used. The most numerous are gas lifts, which are found at 321 wells; 120 of these are wire line installations, 81 having differential pressure valves, 18 intermittent pneumatic flow chambers, 61 plunger lifts, 35 straight gas lifts and 6 jet collars. There are 112 pumping units in operation, of which four are standard rigs, 92 rotary type counterbalance, and 16 air type counterbalance. The polish rod load on these pumping units is 25,000 to 30,000 lbs.; most of them are single reduction gear boxes of 51.7 to 70.5 horsepower, twin crank design and stroke ranges of 34 to 74 inches. Various types of engines rating up to 600 horse-power are in use.

The paper is an interesting contribution in that it shows how the choice of lifting equipment depends on the characteristics of the wells. There are still 509 wells in the field on natural flow.

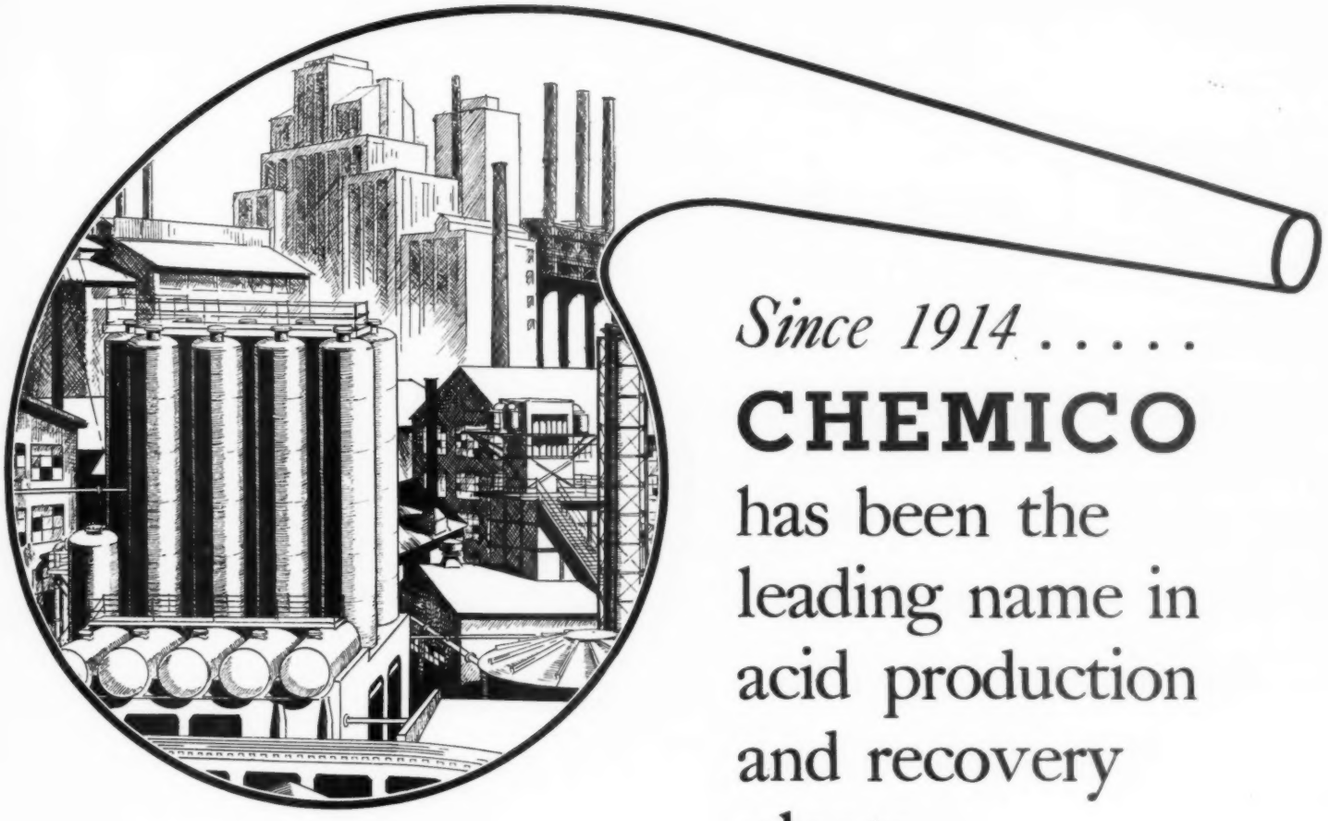
NATURAL GAS

Utilization of Natural Gas for Chemical Products—Harold M. Smith in BUREAU OF MINES INFORMATION CIRCULAR, No. 7180, April, 1940; 7 pages, with numerous diagrams.

Data accumulated by petroleum chemists throughout the world, particularly since about 1930, have shown that the hydrocarbons of natural gas will react when activated by the effects of heat, pressure, chemical reagents, and light; also that the reactions can be made to proceed at practicable speeds and to provide good yields of useful products with moderate operating conditions, especially if catalysts are employed. As these results became known, the possibility of a synthetic organic chemical industry based upon these reactions became apparent, and today this industry is large and growing rapidly in importance.

In this paper the story of the manufacture of chemical products from natural gas is told simply in graphic form. The industry is developing so rapidly that some products may have been omitted, but every effort has been made to include all that are important or likely to become so. The difficulty of keeping information of this type up to date is shown by reference to an information circular on the same subject published by the Bureau of Mines in 1930, in which the important products are shown on a single chart, whereas five charts are employed for the same purpose at present.

The products now being made include primary materials for synthesizing practically all products listed as organic chemicals. They are ob-



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tained by a variety of processes: decomposition (thermal, catalytic, electric), oxidation, halogenation and nitration.

The main problem of synthetic chemistry is to find means of overcoming the difficulties in the way of using methane, which is both the most abundant and the most resistant component of natural gas.

Underground Storage of Gas.—C. U. Daniels, before AMERICAN GAS ASSOC., Natural Gas Section, Houston, May, 1940.

The feasibility of buying "dump" or distress gas and storing it underground for serving the Tulsa market was demonstrated on a small structure involving about 500 acres where the abandonment pressure was 83 pounds. The sand (Dutcher) lies at the 1,750 foot level, is about 45 feet thick and has a porosity estimated at 20 percent, with a total calculated storage capacity of 13,100 M.c.f. All the old wells on the property were plugged except one, and through this one the the purchased gas is pumped to create a pressure of 175 lbs. Regular service has been furnished since April, 1938, with alternating cycles of injection and withdrawal.

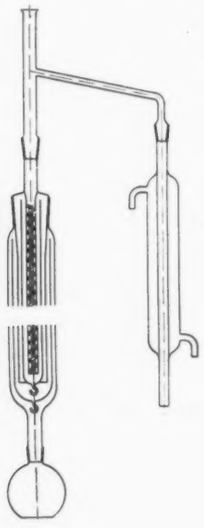
It is noted that the shut-in rock pressure of the reservoir tends to increase. Experiment and calculation shows that this increase is not due to the building up of a water drive, but that gas is being slowly fed into the reservoir structure from some other source, either from minor adjacent accumulations or from shaly lenses far down in the reservoir sand.

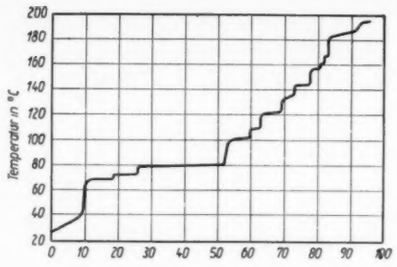
PHYSICS

Separation of Hydrogen Mixtures by Fine Fractionation. C. Koeppel, in OEL UND KOHLE, Vol. 36 (1940), No. 21, pp. 194-195.

In certain cases the only practicable means of investigating the composition of a hydrocarbon mixture is a fractional distillation which will separate the components according to their boiling points. The sharpness of this separation depends on the design of the laboratory fractionating column, of which several are well known, such as the Podbielniak, Bruckner, Macura and Grosse, Frenske and the Tongberg-Quiggle columns.

The author here contributes another design which differs considerably from earlier types.





The construction of his column is indicated in the accompanying sketch. The liquid (about 100 ml.) to be distilled is contained in a glass flask which is surmounted by the column. The latter consists of five concentric glass tubes arranged in the manner shown. The distilled vapor ascends the annular space between the walls of the outer and the next inner tubes, then down between the second and third tubes, and so on until the lightest fraction passes out to the condenser. The liquid condenser in each annular space is returned to the flask through a siphon.

The apparatus has the following special characteristics: there is no filling or other arrangement to produce a bubbling effect; the vapors have a minimum of contact with condensed liquid; the only outer insulation required is a simple asbestos-wrapped iron tube into which the column is placed (not even this is necessary in short columns (750 mm), as the outer shell insulates the inner ones). Ordinarily a distillation with this column need not consume more than two or three hours.

From the distillation curves shown in the paper it appears that a mixture such as 40 benzene, 5 toluene, 5 xylene, 25 o-cresol and 25 p-cresol may be separated with almost perfect accuracy. The distillation curve (temperatures against fractions in percent) here reproduced is that of an Esso gasoline.

The accuracy of the column may be increased by increasing the number of concentric tubes; a nest of seven tubes has been made and used with success.

Development of a New Thread Lubricant—H. J. Beckert and W. M. Frame, before AMERICAN PETROLEUM INSTITUTE, Fort Worth Meeting, May, 1940.

Because of dissatisfaction with the lubricants used on pipe threads, a drastic leak test was devised in which 2-in. pipe specimens were tested with internal gas pressure at different temperatures, and with the specimens subjected to vibration. The results of tests on 148 specimens made up with 11 different thread lubricants are given.

The results of these tests proved that the usual zinc thread lubricant is entirely inadequate for resisting leakage under these test conditions. No other available thread lubricant was found which met all the requirements; therefore, it was decided to develop a new one.

Ideal requirements for a thread lubricant were established, and a lubricant was developed which met these requirements as demonstrated by test. This lubricant consists of 50 percent aluminum-soap grease and 50 percent natural Mexican clay-base graphite composed of both coarse and fine particles. This grease is being manufactured by one of the large grease makers, and is being used on certain classes of both welded and seamless pipe.

The authors say that any one who desires to use it may do so.

CHEMISTRY

Destructive Hydrogenation of High - Molecular Weight Polymers. — Vladimir A. Ipatieff and Raymond E. Schaad, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 32 (1940), No. 6, pp. 762-764.

Destructive hydrogenation under pressure in the presence of nickel oxide and molybdenum oxide has been used to show the presence of naphthenic hydrocarbons in high-boiling olefin polymer. It was of interest to apply this tool to other hydrocarbons having large molecules, especially rubber and synthetic rubberlike polymers.

The destructive hydrogenation of isobutene polymer yielded paraffinic hydrocarbons only, including isobutane in the gases. Butadiene polymer, on the other hand, gave only naphthenic products, chiefly ethylcyclohexane and a dicyclic hydrocarbon. Similarly, natural rubber yielded naphthenes only, with *p*-methylisopropylcyclohexane as the major constituent of the lower boiling portion of the product. Isoprene, under the conditions used for the destructive hydrogenation of the rubber, yielded isopentane and an unsaturated naphthene (i.e., a hydropolymer of isoprene) which was converted into *p*-methyl-isopropylcyclohexane by further hydrogenation.

The fact that the rubber-like isobutene polymers produced only paraffinic hydrocarbons is taken to show that these polymers probably had long aliphatic carbon chains.

The Synthesis of Lubricating Oils by Condensation Reactions—W. R. Wiggins, T. G. Hunter and A. W. Nash, in JOURNAL INSTITUTE PETROLEUM, Vol. 26 (1940), No. 197, pp. 129-145.

Chlorinated paraffin waxes can be condensed with aromatic hydrocarbons, using metallic aluminum as catalyst to give viscous hydrocarbon oils. The oils have high viscosity indices, and the viscosity-gravity constants are in many cases comparable to those of paraffin base oils. The Conradson carbon residues of the benzene and toluene condensation oils are extremely low. All the condensation oils have good oxidation resistance; after oxidation the change in color is small, no asphalt is deposited, and the increase in viscosity is similar to that of commercial motor lubricants.

Induced Pyrolysis of Methane—W. J. Hessels, D. W. van Krevelen and H. I. Waterman, in JOURNAL SOCIETY CHEMICAL INDUSTRY, Vol. 58 (1939), pp. 323-327.

The most abundant of all the natural gaseous hydrocarbons is methane, which is also the most stable and resistant to decomposition by heat. This resistivity of methane has limited the possibility of its industrial use mostly to fuel purposes and to the manufacture of carbon black. This is somewhat regrettable, because of the relative scarcity of the less stable gases such as ethane, propane, butane, etc., which more or less readily offer themselves as raw materials for organic synthesis.

Profiting by hints from the experience of German investigators the authors have opened a way which, if followed up, may bring methane more conveniently into the orbit of chemical technology. The new way depends on the following considerations:

When methane is heated by passage through tubes heated to a very high temperature some acetylene, benzene and other aromatic hydro-